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COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN II)
Northern and Central California, Nevada, and Utah
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Prepared For:

DEPARTMENT OF THE NAVY
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HUNTERS POINT SHIPYARD
SAN FRANCISCO, CALIFORNIA

ENGINEERING EVALUATION/COST ANALYSIS
SITE IR-1/21: INDUSTRIAL LANDFILL
GROUNDWATER PLUME
FINAL

July 26, 1996

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ACRONYMS AND ABBREVIATIONS

ac-ft/yr	Acre-feet per year
APEN	Air pollution emission notice
ARAR	Applicable or relevant and appropriate requirement
AWQC	Ambient water quality criteria
BAAQMD	Bay Area Air Quality Management District
BAT	Best available technology
BCT	Best conventional control technology
bgs	Below ground surface
BP	Biopolymer
CAMU	Corrective action management unit
CB	Cement bentonite
CCR	California Code of Regulations
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
CLEAN	Comprehensive Long-term Environmental Action Navy
COC	Chemical of concern
cm/sec	Centimeters per second
CPT	Cone penetrometer test
CRC	Coastal Resources Coordination
CTO	Contract task order
CWA	Clean Water Act
DTSC	Department of Toxic Substances Control
EE/CA	Engineering evaluation/cost analysis
EFA WEST	Engineering Field Activity West, Naval Facilities Engineering Command
EPA	U.S. Environmental Protection Agency
FFA	Federal facilities agreement
FS	Feasibility study
ft/day	Feet per day
ft/ft	Feet per foot
gpd	Gallons per day
gpm	Gallons per minute
HGAL	Hunters Point Groundwater Ambient Level
HLA	Harding Lawson Associates
HP	HydroPunch
HPS	Hunters Point Shipyard
HWCA	Hazardous Waste Control Act
IAL	Interim ambient level
IAS	Initial assessment study
IR	Installation Restoration
LDR	Land disposal restriction
LUFT	Leaking underground fuel tank

ACRONYMS AND ABBREVIATIONS (Continued)

MCLs	Maximum contaminant levels
μg/kg	Micrograms per kilogram
μg/L	Micrograms per liter
mg/kg	Milligram per kilogram
mg/L	Milligram per liter
msl	Mean sea level
Navy	U.S. Department of the Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
O&M	Operation and maintenance
OSHA	Occupational Safety and Health Administration
OU	Operable unit
PAH	Polynuclear aromatic hydrocarbon
PCB	Polychlorinated biphenyl
pCi/L	PicoCuries per liter
POTW	Publicly owned treatment works
PPE	Personal protective equipment
PRC	PRC Environmental Management, Inc.
PVC	Polyvinyl chloride
Qaf	Artificial fill
Qbm	Bay mud deposits
Qu	Undifferentiated sedimentary deposits
Quus	Undifferentiated upper sand deposits
RA	Remedial action
RAO	Remedial action objective
RCRA	Resource Conservation and Recovery Act
RI	Remedial investigation
ROD	Record of decision
RWQCB	Regional Water Quality Control Board-San Francisco Bay Region
SACM	Superfund Accelerated Cleanup Model
SARA	Superfund Amendments and Reauthorization Act of 1986
SB	Soil bentonite
Sp, KJsk	Franciscan bedrock
SVOC	Semivolatile organic compound
SWRCB	State Water Resources Control Board
TBC	To be considered
TDS	Total dissolved solids
TPH	Total petroleum hydrocarbon
TOG	Total oil and grease
Triple A	Triple A Machine Shop
TSD	Treatment, storage, or disposal
UST	Underground storage tank
VOC	Volatile organic compound

EXECUTIVE SUMMARY

This engineering evaluation/cost analysis (EE/CA) was prepared in accordance with current U.S. Environmental Protection Agency (EPA) and U.S. Navy guidance documents for a non-time critical removal action under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The removal action is necessary to address groundwater contamination from Site IR-1/21 at Hunter's Point Shipyard (HPS). This report summarizes the results of the EE/CA process, characterizes the site, identifies removal action objectives (RAOs), describes and analyzes removal action alternatives, and describes the recommended removal action alternative.

Hunter's Point Shipyard (HPS) has been operated as a shipyard since 1869 and produced Liberty ships during World War II. Other Navy ships were also modified, maintained, and repaired at HPS Shipyard operations ceased in 1974, and the facility was placed in industrial reserve. From 1976 to 1986, Triple A Machine Shop leased most of HPS from the Navy and operated a commercial ship-repair service. A 36-acre industrial landfill, Site IR-1/21, is located along the southwestern shoreline of HPS, in Parcel E. The filling history of Site IR-1/21 is not well documented, but it appears the landfill was filled between 1942 and 1974 based on aerial photography. Shipyard wastes may have included construction and industrial debris and waste, sandblast waste, domestic refuse, paints, and solvents, all deposited between 1958 and 1974 (WESTEC 1984). Groundwater investigations have identified a plume of groundwater contamination emanating from the landfill and potentially migrating toward San Francisco Bay. The contamination plume contains relatively low concentrations of volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), total petroleum hydrocarbons (TPHs), and polychlorinated biphenyls (PCBs). An overview of all organic and inorganic contaminant profiles is presented; however, the removal action will focus on contamination that poses a potential immediate threat to receptors.

CERCLA and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (Title 40 Code of Federal Regulations [40 CFR] Part 300) define removal actions as the cleanup or removal of released hazardous substances, actions to monitor the threat of release of hazardous substances, and actions to mitigate or prevent damage to public health or welfare or the environment. A removal action is planned to prevent Site IR-1/21 groundwater contamination from moving into San Francisco Bay. The objective of this removal action is to protect human health and the environment from potential immediate threats posed by groundwater contamination. The scope of this removal action is contaminated groundwater containment. Threats to human health may result from exposure through the ingestion of fish and other aquatic life. Threats to the environment may result from exposure to contaminated groundwater through migration into San Francisco Bay. To meet the objective, an EE/CA is conducted. The EE/CA first determines whether groundwater contamination poses an immediate threat to receptors in San Francisco Bay.

To evaluate whether potentially unsafe levels of contamination may be moving into the bay, maximum groundwater contaminant levels detected in near-bay groundwater monitoring wells are compared to water quality screening criteria (see Section 2.8.3). The screening criteria have been developed to indicate the level at which there is the potential for harmful impacts to human health via ingestion of fish, as well as a potential for harmful impacts to the environment. If the highest contaminant concentrations in groundwater monitoring wells are below screening criteria levels, environmental impacts are considered nonthreatening. If groundwater contaminant concentrations exceed the screening criteria levels in samples collected from monitoring wells, a potential impact exists. The magnitude and number of detections are also taken into account to determine the areas where a removal action is justified. At Site IR-1/21, VOCs, SVOCs, PCBs, and inorganic constituents in groundwater exceed screening criteria levels. However, PCBs pose the greatest threat because there are numerous detections well above screening criteria.

The EE/CA examines the implementability, effectiveness, and cost of various options to contain groundwater contaminant migration and evaluates applicable regulatory requirements. The primary options available for reducing groundwater contaminant migration are watertight barriers, groundwater extraction, and porous underground treatment walls. Because underground treatment walls were found to be unproven and unreliable for contaminants of concern at Site IR-1/21, the four alternatives considered in the EE/CA are:

Alternative 1: No Action

Alternative 2: Groundwater Containment with Sheet Piling, Groundwater Extraction with Well Points, Discharge to the Sanitary Sewer

Alternative 3: Groundwater Containment with Slurry Wall, Groundwater Extraction with Well Points, Discharge to the Sanitary Sewer

Alternative 4: Groundwater Containment and Extraction with a Biopolymer Slurry Trench, Discharge to the Sanitary Sewer

Any groundwater withdrawn during the removal action will be discharged to the sewage treatment plant because there is a regulatory preference for discharge to a sewage system over discharge to the storm drain (RWQCB 1995) and because of the temporary nature of the removal action (the remedial investigation and feasibility study [RI/FS] process will identify the final remedy for the site).

Based on analyses contained in this report, the Navy recommends Alternative 2. This alternative best meets the NCP criteria of overall protectiveness of human health, compliance with applicable or relevant and appropriate requirements (ARARs), effectiveness, implementability, and cost. Alternative 2 is the preferred option for the removal action because (1) it will effectively restrict the movement of the hazardous substances into the bay; (2) it is a proven technology and can be readily installed; and (3) it offers a high degree of reliability at a reasonably low cost. Based on available data, the underground soil observed at Site IR-1/21 is favorable for driving sheet pile. Well points were selected to extract groundwater because they are well-suited for shallow areas like Site IR-1/21 and provide a versatile means to control groundwater flow.

Under Alternative 2, contaminant migration will be controlled by installing sheet pile. Sheet pile are thick, interlocking steel plates that are driven into the ground to form an underground wall between the landfill and San Francisco Bay. The steel sheets are driven into the ground until they reach an underground, natural layer of clay. The clay layer will limit the amount of contamination that can migrate under the wall. Near the shoreline of Site IR-1/21, clays exist at about 15 feet below ground surface and an effective seal could be established. In addition to using sheet pile, Alternative 2 includes groundwater extraction with well points followed by discharge to the local sewage treatment plant.

Additional field work will be necessary to finalize the implementation of Alternative 2. This additional field work will be conducted as Phase I of design and construction. A detailed description of the Phase I field work is presented in the Removal Action Implementation Work Plan (PRC 1996d). The objectives of the additional field investigation are to (1) confirm the boundaries of the contaminant plume along the length of shoreline, (2) confirm that the lithology is favorable for driving sheet pile along the proposed containment wall alignment, and (3) locate the Bay Mud/artificial fill aquifer interface along the proposed containment wall alignment. The proposed containment wall placement relative to the shoreline will likely remain unchanged. The shoreline is a relatively steep embankment in places and the whole stretch of shoreline paralleling the proposed alignment of the containment wall is covered with concrete rubble, reinforcing rod, and other rocky rubble as a rip rap armour. The conclusions and recommendations presented in this EE/CA will be revisited after results of the additional field work are evaluated.

1.0 INTRODUCTION

PRC Environmental Management, Inc. (PRC), received Contract Task Order (CTO) No. 007 under Comprehensive Long-term Environmental Action Navy (CLEAN) II Contract No. N62474-94-D-7609 from the U.S. Department of the Navy, Engineering Field Activity West, Naval Facilities Engineering Command (EFA WEST), to prepare removal action documentation for four non-time critical removal actions at Hunters Point Shipyard (HPS) in San Francisco, California. The removal actions include: (1) the storm drain system; (2) soil and floating product in Parcel E; (3) groundwater plume in Site IR-1/21 of Parcel E; and (4) exploratory excavations. Groundwater removal actions are no longer being pursued in Parcels B and C. Because the groundwater contamination in these plumes was farther from the bay than the contamination in the Parcel E groundwater plume, the Parcel B and C groundwater plumes were determined not to pose a potential immediate threat to receptors. These Parcels will be addressed in the remedial investigation and feasibility study (RI/FS) process. This engineering evaluation/cost analysis (EE/CA) identifies removal action screening criteria levels for groundwater, identifies areas of concern, and evaluates removal action alternatives for contaminated groundwater containment within Site IR-1/21 of Parcel E.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP) define removal actions to include "the cleanup or removal of released hazardous substances from the environment, such actions as may necessarily be taken in the event of the threat of release of hazardous substance into the environment, such action as may be necessary to monitor, assess, and evaluate the release or threat of release of hazardous substances, the disposal of removal material, or the taking of such other actions as may be necessary to prevent, minimize or mitigate damage to the public health or welfare or to the environment, which may otherwise result from a release or threat of release." The U.S. Environmental Protection Agency (EPA) has classified removal actions into three types based on the circumstance surrounding the release or threat of release: emergency, time critical, and non-time critical. The groundwater response action at HPS has been determined to be a non-time critical removal, since on-site action will start more than 6 months after the planning period begins.

HPS includes a 36-acre industrial landfill (Site IR-1/21) along its southwestern shoreline. Groundwater contamination resulting from Site IR-1/21 has been identified during previous investigations. The results of these investigations will be presented in the Parcel E RI report to be completed in April 1997. The groundwater contains relatively low concentrations of organic compounds (such as volatile organic compounds [VOCs], semivolatile organic compounds [SVOCs], polychlorinated biphenyls [PCBs], total petroleum hydrocarbons [TPH]), and inorganic compounds. An overview of all organic and inorganic contaminant profiles are presented; however, the removal action will focus on contamination that poses a potential immediate threat to receptors. The source of most organic contamination is assumed to be debris in the landfill. Some landfill debris is located below the water table, and may act as a continuous source of groundwater contamination migrating toward San Francisco Bay.

This EE/CA addresses the implementability, effectiveness, and cost of groundwater containment actions and evaluates applicable regulatory requirements. The Navy is the lead agency for the removal action. As the lead agency, the Navy has final approval authority for the recommended alternative selected and overall public participation activities. As specified in the Federal Facilities Agreement (FFA) for HPS, the Navy is working in cooperation with EPA Region 9, the California Department of Toxic Substances Control (DTSC), and the Regional Water Quality Control Board (RWQCB) in implementing this removal action.

This EE/CA report:

- Summarizes and evaluates current knowledge of the extent of contaminated groundwater near the shoreline of Site IR-1/21
- Identifies areas of concern
- Identifies and evaluates potential groundwater containment alternatives
- Provides a basis for selecting a recommended groundwater containment alternative
- Satisfies administrative record requirements for documenting the recommended removal action alternative

The report has eight sections and eight supporting appendices. This introduction explains the purpose and framework of this removal action. Section 2.0 presents site characterization information for HPS; Section 3.0 discusses the removal action scope, objectives, and goals; in Section 4.0, potential technologies are screened; Section 5.0 evaluates removal action alternatives; Section 6.0 presents a comparative analysis of removal action alternatives; and Section 7.0 discusses the recommended removal action alternative. References used to prepare this EE/CA report are listed in the final section. Appendix A presents a geologic cross-section of Site IR-1/21; Appendix B presents water-level elevation contour maps; Appendix C presents maximum chemical concentrations in soil at Site IR-1/21; Appendix D presents groundwater chemical data from wells near the bay; Appendix E contains borelogs from near-shoreline locations; and Appendix F presents cost opinion details for each removal action alternative. Appendix G presents March 1996 groundwater analytical results. Appendix H presents the Navy's responses to regulatory agency comments on the draft and draft final EE/CA.

1.1 REMOVAL ACTION APPROACH

The objective of this removal action is to protect human health and the environment from potential immediate threats posed by groundwater contamination. The scope of this removal action is groundwater containment. Threats to human health may result from exposure to contamination through the ingestion of fish. Threats to the environment may result from exposure to contaminated groundwater through migration into San Francisco Bay. To determine whether groundwater contamination poses an immediate threat, this EE/CA focuses on groundwater chemical concentrations detected in monitoring wells nearest San Francisco Bay. At Site IR-1/21, there are seven wells along the shoreline. Evaluating groundwater chemistry in these wells gives the best representation of the contamination levels potentially migrating into the bay. To evaluate whether unsafe levels of contamination are potentially migrating into the bay, maximum groundwater contaminant levels detected in samples from these seven wells are compared to water quality screening criteria. The screening criteria are based on toxicity information developed for the protection of both human health and aquatic life. Section 2.8.3 discusses the screening criteria in more detail.

The screening criteria are used to indicate contaminant levels at which there is a potential for harmful impacts to human health via ingestion of fish, as well as a potential for harmful impact to the environment. Chemical contamination in groundwater is screened on a constituent basis against screening criteria. For example, the constituents of TPH (benzene, ethyl benzene, toluene, xylene, naphthalene) are screened, rather than TPH. The magnitude and number of detections are also taken into account to identify areas that warrant a removal action. Areas where contamination is detected sporadically and inconsistently will be further evaluated during the RI/FS process using site-specific data. If maximum detected chemical concentrations in groundwater monitoring wells are below screening levels, impacts to human health and the environment are not considered to pose an immediate threat. If groundwater concentrations consistently exceed the screening levels in samples collected from monitoring wells, a potential immediate impact exists and a removal action may be appropriate. The Navy believes that the screening criteria are conservative since site-specific fate and transport information and ambient levels in surface water are not integrated into the assessment. The Navy and regulatory agencies agreed that the screening criteria will not be the sole determining factor in identifying a removal action area. The Navy feels that recommending a removal action for a site where samples have not been collected to confirm that detections are above screening criteria beyond initial detection is not appropriate. Additional confirmatory samples will need to be collected at areas where isolated detections have exceeded screening criteria at Site IR-1/21 during the RI/FS process.

Additional samples were collected in March 1996 in three wells located along the proposed alignment of the sheet pile wall (IR01MWI-3, IR01MW43A, IR01MW44A) to confirm the presence of PCBs above screening levels. Sample results indicated PCB concentrations have decreased by an order of magnitude, but are still above screening levels. Section 2.8.3 and Appendix G present analytical results. Therefore, a removal action is appropriate for this area where contamination has consistently been detected at levels that may pose a threat to human health and the environment.

1.2 REMOVAL ACTION RATIONALE AND STATUTORY FRAMEWORK

The scope and content of this EE/CA are consistent with the EPA "Guidance on Conducting Non-Time-Critical Removal Actions under CERCLA" (EPA 1993) and the NCP (Title 40 of the Code of Federal Regulations Part 300 [40 CFR] Part 300).

The Site IR-1/21 removal action will be conducted in accordance with the requirements of CERCLA as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA) and the NCP. CERCLA response actions are appropriate at sites with releases of (1) hazardous substances, or (2) pollutants or contaminants that present an imminent and substantial endangerment. This EE/CA will use constituent-specific screening criteria to identify areas within Site IR-1/21 that warrant a removal action.

Under Presidential Executive Orders 12580 and 12080, federal agencies have been delegated the authority to conduct and finance removals at federal facilities under their jurisdiction. Under the NCP, the lead agency is authorized to take any appropriate removal action to prevent, minimize, stabilize, mitigate, or eliminate the release or threat of release of hazardous substances, pollutants, or contaminants that constitute a threat to public health, welfare, or the environment. The Navy is the lead agency for CERCLA activities at HPS. Based on the removal action factors in the NCP and the conditions at the HPS sites, the Navy has determined that a removal action is warranted at HPS. Section 300.415(b)(2) of the NCP lists eight factors used to determine the appropriateness of a removal action. Based on the screening criteria, magnitude, and number of detections used for evaluating the analytical data at HPS, the following factor indicates that a removal action is warranted:

- Actual or potential exposure to nearby human populations, animals, or the food chain from hazardous substances or pollutants or contaminants

Removal actions under the NCP provide an effective tool in responding to the overriding mandate of CERCLA to protect public health, welfare, and the environment. Consistent with the Superfund Accelerated Cleanup Model (SACM), which stresses integrating removal and remedial responses, this removal action is intended to be integrated into the final action for the groundwater at Site IR-1/21. The final action for groundwater at Site IR-1/21 will be determined during the Parcel E FS.

EPA has developed guidance and policies for removal actions. CERCLA 120(a)(2) prohibits federal facilities from adopting any policies inconsistent with EPA guidelines and rules. It is therefore Navy policy that response actions follow EPA guidance to determine the reasonable interpretation and application of applicable regulations. In addition, the Navy is working in cooperation with EPA, DTSC, and RWQCB in implementing this removal action. EPA has classified removal actions into three types based on the circumstances surrounding the release or threat of release: emergency, time-critical, and non-time critical. The Navy determined that the Site IR-1/21 removal action at HPS is non-time critical because the sites do not pose an immediate threat to public health, welfare, or the environment; therefore, a planning period of 6 or more months is available. Under the NCP, the Navy, as lead agency, must conduct an EE/CA for all non-time critical removal actions at HPS.

The EE/CA report will be issued in accordance with the community relations plan prepared by the Navy and dated May 1996 (PRC 1996c) and will be updated to facilitate public involvement in the decision making process. The community relations plan encourages the public to review and comment on the recommended removal action described in the EE/CA report. To gain a more thorough understanding of the activities associated with this removal action, the plan also encourages the public to review the administrative record available at EFA WEST offices in San Bruno, California, and the information repository located at the main San Francisco public library on Larkin and McAllister Streets and the Bayview branch library located on Third Street.

2.0 SITE CHARACTERIZATION

HPS is in southeastern San Francisco at the tip of a peninsula extending into San Francisco Bay (see Figure 1). The Navy property encompasses 936 acres, 493 of which are on land and 443 of which are below waters of the bay. About 70 to 80 percent of HPS consists of relatively flat lowlands constructed on artificially filled mudflats. A moderately sloping ridge in the northwestern portion of the site occupies the remaining HPS area. The northern and eastern shores of HPS were developed for ship repair and are equipped with drydock and berthing facilities. HPS has been operated as a shipyard since 1869 and produced Liberty ships during World War II. Other Navy ships were also modified, maintained, and repaired at HPS. Shipyard operations ceased in 1974, and the facility was placed in industrial reserve. Triple A Machine Shop (Triple A) operated HPS as a commercial ship repair facility from 1976 to 1986. Currently, the Navy and private businesses use HPS for limited commercial and light industrial activities. HPS has been divided into five parcels of land, Parcels A through E, plus an additional Parcel F, which includes the subtidal lands.

This section discusses (1) the history of HPS, (2) the HPS installation mission, (3) the environmental setting at HPS and at Site IR-1/21, (4) previous removal activities, (5) the source, nature, and extent of hazardous substances, (6) applicable or relevant and appropriate requirements (ARARs) and (7) the streamlined risk evaluation. Information presented in this section was derived from the Draft Final Parcel A Remedial Investigation Report (PRC 1995b), the data collected during RI field activities at Site IR-1/21, and the HPS Hydrogeologic Report (PRC 1994a). In addition, information presented in Section 2.3.7 was derived from the Phase 1A Ecological Risk Assessment Report (PRC 1994b).

2.1 HPS HISTORY

The promontory on which HPS is located has been recorded in maritime history since 1776, first as Spanish mission lands used for cattle grazing and later for its drydock facilities. HPS's history is discussed below focusing on the time period from 1939, when Congress passed legislation to acquire the land (PRC 1995b), to the present (after Navy acquisition).

In 1940, the U.S. Government received title to the land at Hunters Point and began development. Of the property acquired, Dry Docks No. 2 and 3, two pump houses, a boiler house, a gate house, and a paint storage building still exist and form a historic district. From 1945 to 1974, the shipyard was predominantly used as a repair facility by the Navy. Additional acreage, mostly on the south side of

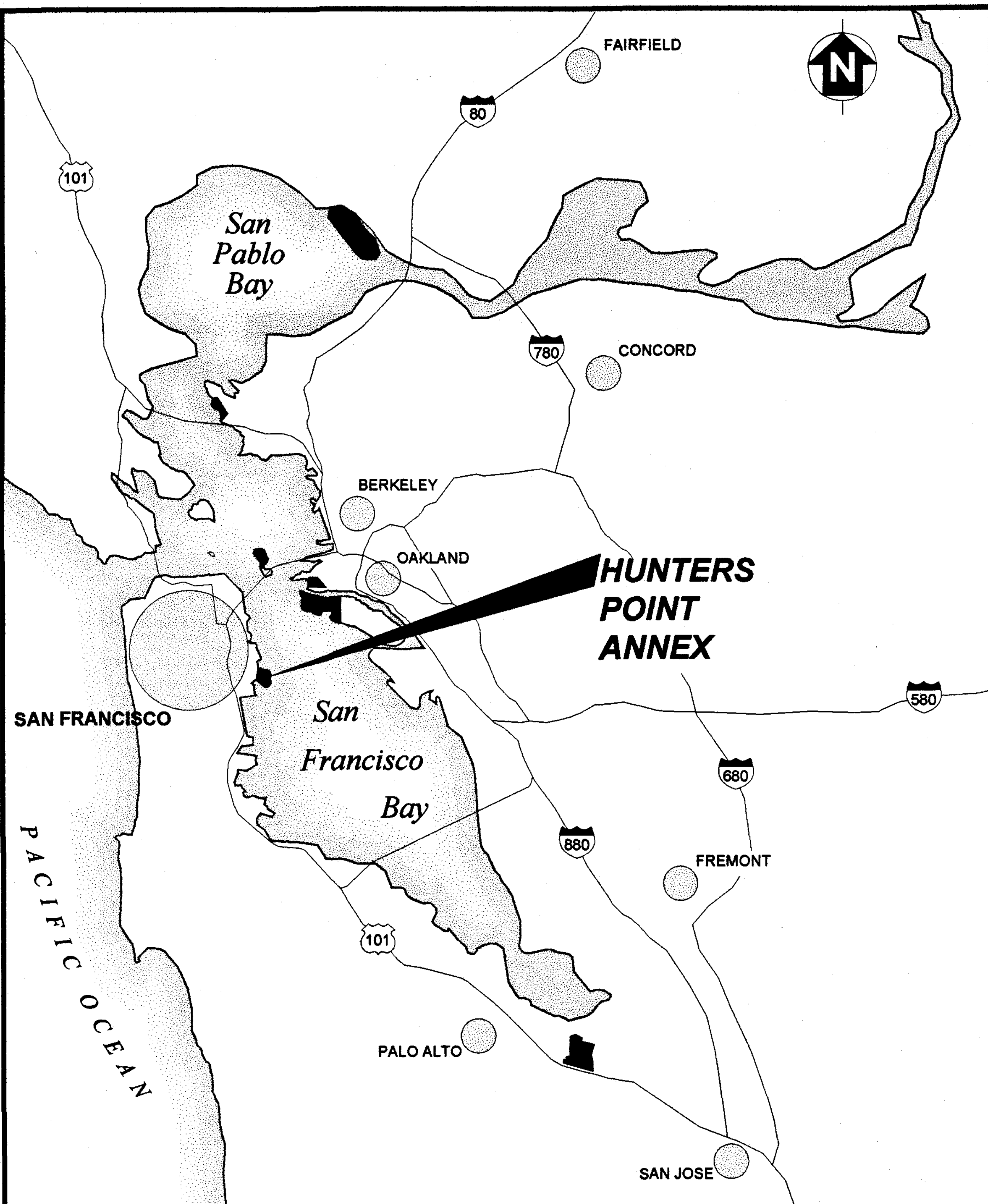

FIGURE 1
HUNTERS POINT ANNEX
FACILITY LOCATION MAP

DATE: 05/07/96 DDJ DN FILE NAME: 069\007C\0203\121\LOC.DS4 the base, was acquired in 1957, increasing the size of the facility. The Navy operated the shipyard as a carrier and ship repair facility through the late 1960s. Hunters Point was deactivated in 1974 and remained relatively unused until 1976.

In 1976, the Navy leased 98 percent of Hunters Point to a private ship repair company, Triple A. Triple A leased the property from July 1, 1976, to June 30, 1986. Triple A did not vacate the property until March 1987. During the lease period, Triple A used dry docks, berths, machine shops, power plants, various offices, and warehouses to repair commercial and Naval vessels. Triple A also subleased portions of the property to various other businesses.

In 1986, the Navy resumed occupancy of Hunters Point. Many of the subtenants under Triple A's lease remained tenants under the Navy's subsequent reoccupancy in 1986. From November 1985 to August 1989, several Navy surface ships were docked at the property.

Because of the presence of hazardous materials from past shipyard operations, the Hunters Point property was placed on the National Priorities List in 1989 as a Superfund site pursuant to CERCLA. The Hunters Point Naval Shipyard then came under the administrative jurisdiction of Treasure Island Naval Station in 1990 and was named Hunters Point Annex. From April 1990 to March 1994, Hunters Point Naval Shipyard was an annex of Treasure Island Naval Station.

In 1991, HPS was slated for closure pursuant to the Defense Base Realignment and Closure Act of 1990 (Public Law 101-510). Closure activities at HPS involve environmental remediation and making the property available for nondefense use. On March 31, 1994, control of HPS was transferred from Treasure Island Naval Station to the Naval Facilities Engineering Command, Western Division in San Bruno, California (now EFA WEST).

2.2 HPS INSTALLATION MISSION

HPS was primarily used for the industrial modification, maintenance, and repair of ships. The mission of the shipyard before its decommission in 1974 was to provide logistical support for assigned ships and service craft; to perform authorized work in connection with the construction, conversion, overhaul, repair, alteration, drydocking, and outfitting of ships and craft, as assigned by the Navy; to conduct research, development, and test work, as assigned by the Navy; and to provide services and materials for other activities and to other units as directed by a competent authority.

2.3 HPS ENVIRONMENTAL SETTING

This section summarizes HPS's climate and meteorology, surface features, topography, surface water drainage, geology, soils, hydrogeology, and ecology. Groundwater use is discussed in Section 2.8.1.

2.3.1 Climate and Meteorology

The climate at HPS is characterized by partly cloudy, cool summers with little precipitation and mostly clear, mild winters with rainstorms. The average annual precipitation is about 19 inches. Air monitoring conducted at HPS indicates that the prevailing wind direction is west to east; therefore, airborne dust and volatile emissions would probably be transported primarily off shore to the east-southeast. The average and maximum wind speeds at HPS are approximately 5 and 10 meters per second, respectively.

2.3.2 Surface Features and Topography

About 70 to 80 percent of HPS consists of relatively level lowlands (comprising Parcels B, C, D, and E) constructed by excavating portions of the Hunters Point ridge and placing fill materials along the San Francisco Bay margin. The remaining land consists of much of Parcel A and is a moderately to steeply sloping ridge in the northwest portion of HPS. Most of the lowlands are covered with asphalt, buildings, or other structures. The uplands are covered with asphalt, buildings, and vegetation. Elevations range from 0 to 22 feet above mean sea level (msl) in the lowlands to 180 feet above msl at the ridge crest in Parcel A.

2.3.3 Surface Water Drainage

Surface water drainage at HPS appears to primarily consist of sheet-flow runoff that collects in the on-site storm drain system and discharges through the storm drain system into San Francisco Bay through several outfalls. Locally, some surface water runoff may enter catch basins connected to the sanitary sewer system (YEI 1988). Ultimately, surface water runoff that enters the HPS sanitary sewer discharges to the San Francisco sanitary sewer system. No naturally occurring channelized drainage exists. All preexisting drainage channels have been filled or modified by construction over the years.

2.3.4 Geology

Six geologic units underlie HPS, the youngest of Quaternary age and the oldest of Jurassic-Cretaceous age. In general, the stratigraphic sequence of these units, from top to bottom, is as follows: artificial fill; slope debris and ravine fill; undifferentiated upper sand deposits; Bay Mud deposits; undifferentiated sedimentary deposits; and Franciscan Assemblage bedrock. The peninsula forming HPS is within a northwest trending belt of Franciscan Assemblage bedrock known as the Hunters Point Shear Zone. The rocks within this zone are intensely deformed and sheared. Serpentinite is the predominant rock type, but other rock types characteristic of Franciscan Assemblage bedrock are also present.

Serpentinite is subdivided into two general textural types: a relatively hard serpentinite and an intensely sheared, friable, and weak to plastic serpentinite. Stronger and more brittle rock types, such as graywacke and hard serpentinite, have very low primary porosity and permeability; however, some secondary porosity and permeability result from the presence of open fractures. Surrounding the brittle rock types, sheared serpentinite and shales form a matrix of relatively fine-grained rocks with low porosity and permeability.

2.3.5 Soils

Three soil surveys have been performed by the U.S. Department of Agriculture in the San Francisco area and include HPS. In general, soils at HPS are derived from underlying rocks and weathered material or were imported as fill. Parcels B through E are primarily covered by bottom land soils. Bottom land soils exist in areas that were once part of San Francisco Bay and adjacent tidal flats. The properties and characteristics of these soils are highly variable because of differences in the type and amount of fill material used. Surface water runoff over bottom land soils is slow, and water-erosion is low.

2.3.6 Hydrogeology

Three aquifers have been identified at HPS and are designated the A-aquifer; the undifferentiated sedimentary aquifer, or B-aquifer; and water in localized fractures of bedrock. The A-aquifer consists of saturated fill materials and undifferentiated upper sand deposits overlying Bay Mud. The A-aquifer may overlie bedrock in excavated areas next to the former shoreline. In the lowland areas of HPS, depths to groundwater range from 2 to 15 feet bgs. Some areas have a permanent water table at a depth of 30 to 60 inches below ground surface (bgs) because of fluctuating tides. The B-aquifer consists of undifferentiated sedimentary deposits underlying Bay Mud and overlying Franciscan Assemblage bedrock. The bedrock aquifer consists of the upper weathered and deeper fractured portions of the Franciscan bedrock. The bedrock aquifer appears to be in direct hydraulic communication with the A-aquifer where the A-aquifer directly overlies it.

2.3.7 Ecology

The ecology of HPS includes aquatic environments, limited terrestrial areas, and transition (wetlands) zones, all of which have been physically disturbed by human activities, such as dredging, excavation, filling, and land development. The aquatic environment includes the intertidal zone and subtidal areas surrounding HPS. Terrestrial habitat is present at Parcel A in the upper residential hill area, Parcel E in the fill area and the landfill, and on a limited basis in Parcel B. Pockets of salt marshes are located along the southern shore of HPS in Parcel E.

The intertidal zones provide foraging habitat for migratory and resident shorebirds. Approximately 50 different species of fish have been reported in surveys conducted in water near HPS by the California Department of Fish and Game between 1980 and 1985 (PRC 1994b). The species assemblage as represented is typical of harbor or marina settings and does not reveal the existence of any rare or endangered fish species.

Most of HPS's terrestrial habitat is currently covered with asphalt, buildings, or other structures. The vegetated areas of HPS comprise four distinct terrestrial habitats. In order of decreasing area, these habitats include ruderal (disturbed), landscape, nonnative grassland, and salt marsh areas. Almost all of the terrestrial habitat of potential ecological concern is located in Parcel A; however, Parcel E contains ruderal habitats and salt marshes.

The ruderal habitat consists of aggressive colonial plant species. The habitat is dominated by serpentinite minerals and associated soils that contain elevated levels of naturally occurring heavy metals such as nickel and chromium. The heavy metal content of the serpentinite-derived soils restricts the variety of plants growing in this habitat to species that can tolerate and adapt to the xenobiotic metals. The Navy conducted a wetlands delineation of HPS in July 1991. Salt marsh habitats were identified along the bay margin at Parcel E. The vegetation of the salt marshes provides habitat for migratory and resident shorebirds. In addition, the vegetation provides suitable habitat for the salt marsh harvest mouse, which is classified as both a Federal and California endangered species.

2.4 SITE IR-1/21 ENVIRONMENTAL SETTING

This section summarizes Site IR-1/21's history, surface features and topography, geology, and hydrogeology.

2.4.1 Industrial Landfill Site Description and History

The industrial landfill, Site IR-1/21, is a 36 acre, horseshoe-shaped area along the southwestern shoreline of HPS (see Figure 2). The south and southwestern portions of the site along the San Francisco Bay are generally flat. The rest of the site rises gradually to the north, to a maximum elevation of 22 feet above msl.

The site is unpaved except in the north, along the former alignment of Spear Avenue, and in the northeast, where a large area is covered with concrete. The surface of the concrete is rough and uneven; the concrete was probably poured by a past tenant. The rest of the site is bare soil or is covered with seasonal vegetation. The shoreline is locally covered with rip rap and assorted rubble such as broken asphalt and brick.

The filling history of Site IR-1/21 is not well documented. Aerial photos indicate that filling of the bay on the east side of the site began in the 1940s. Review of these photographs indicates that artificial fill, composed primarily of serpentinite, was placed on native bay sediments during bay filling operations from 1942 to 1946. The west side of the site was filled primarily during the 1950s. A wide slough extended from the bay to the north corner of the site; between 1958 and 1974, the Navy reportedly filled this slough with shipyard wastes, including construction and industrial debris and waste, sandblast waste, domestic refuse, paints, and solvents (WESTEC 1984). Filling of the slough was completed in 1974 and the entire site was capped with several feet of clean fill. There are no buildings at Site IR-1/21. Storm water runoff flows across the ground surface and into the bay. Triple A occupied HPS from May 1976 through June 1986. Triple A Sites 1 and 16 are within the industrial landfill. During Triple A's occupancy, unlabeled drums were stored at Triple A Site 1 for an unknown period of time. Ground staining was observed in the vicinity of the drums; the drums were later removed by Triple A. Industrial debris and sandblast waste were disposed of at Triple A Site 16 on the shoreline adjacent to the south access road.

Groundwater contamination resulting from Site IR-1/21 activities has been identified during previous investigations, and these results will be presented in the Parcel E RI report to be completed in April, 1997. The contamination plume contains relatively low concentrations of VOCs, SVOCs,

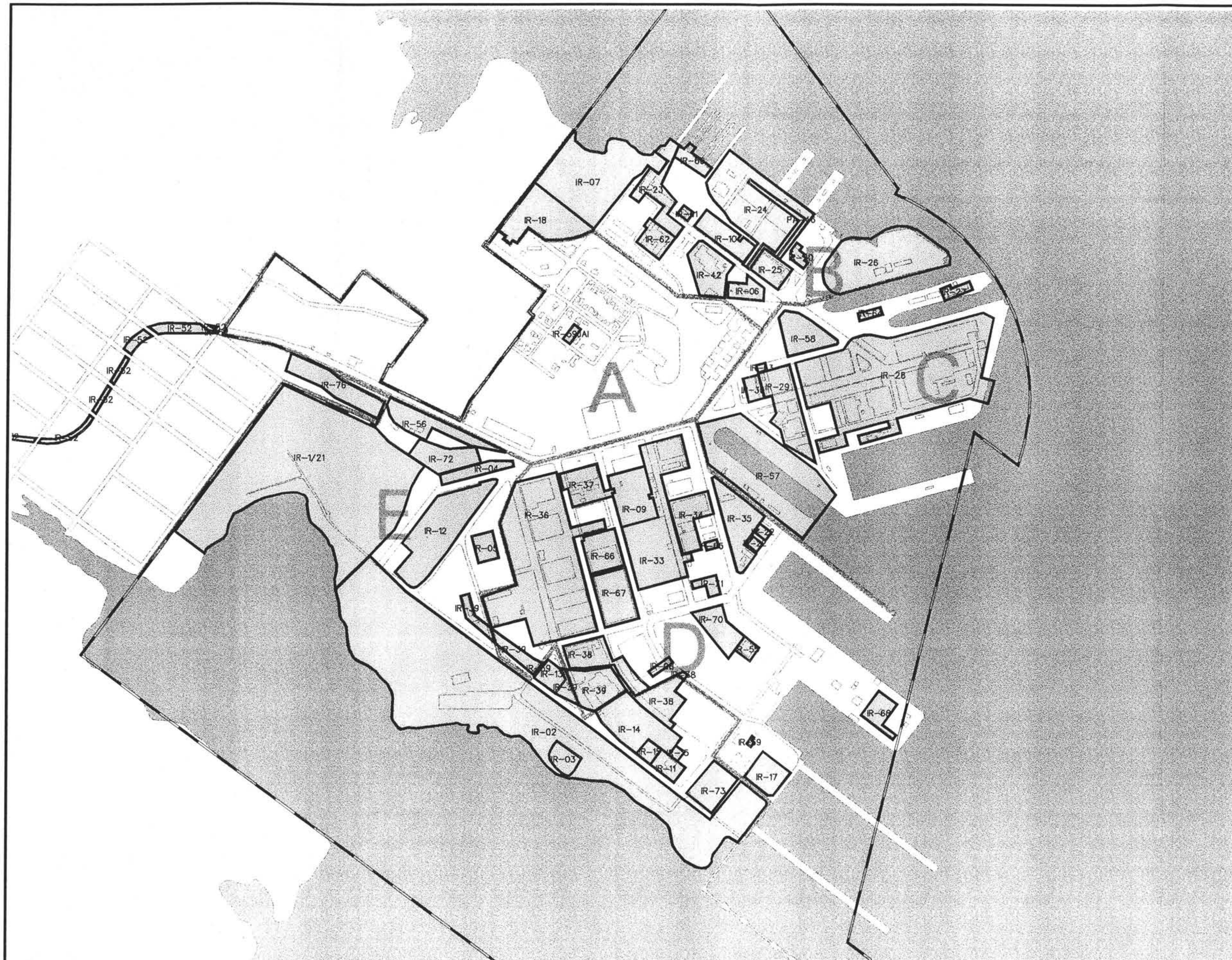

FIGURE 2
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
SITE IR-1/21 EE/CA
FACILITY IR SITES

PCBs, and metals. The source of contamination is assumed to be debris in the landfill. Some landfill debris is located below the water table, is saturated, and likely acts as a continuous source of groundwater contamination. The groundwater contamination plume may be migrating toward San Francisco Bay.

2.4.2 Geology

Six geologic units have been identified at Site IR-1/21. They are, from top to bottom, artificial fill (Qaf), undifferentiated upper sand deposits (Quus), Bay Mud deposits (Qbm), undifferentiated sedimentary deposits (Qu), and Franciscan bedrock (Sp, KJsk). The review of aerial photographs and boring and trench logs indicates that artificial fill and possibly undifferentiated upper sand deposits were placed on top of native geologic materials during filling along the bay margin or during landfill operations between 1958 and 1974.

Preliminary geologic cross sections based on boring and well logs obtained during RI activities were compiled and are contained in Appendix A. These cross sections are generalized to facilitate correlation of major types of fill materials and native geologic sediments. A detailed correlation of various lithology types within artificial fill materials is difficult because of the extreme heterogeneity of these materials. Due to drilling difficulties, several borings were not advanced through the entire thickness of the artificial fill into native sedimentary deposits (undifferentiated upper sand deposits or undifferentiated sedimentary deposits) or Franciscan bedrock. In addition, most of the borings advanced into older sedimentary deposits did not fully penetrate the entire thickness. As a result, only the artificial fill has been extensively characterized. Characteristics of the artificial fill and the occurrences and character of the four other geologic units encountered beneath the artificial fill at Site IR-1/21 are summarized below.

<u>Artificial Fill (Qaf)</u>

Artificial fill deposits were found from the ground surface to depths ranging from 5 to 57 feet bgs at Site IR/1-21. It overlies Bay Mud deposits in most areas with a few exceptions. At IR-1/21, artificial fill overlies undifferentiated upper sand deposits in the north corner of the landfill, where Bay Mud is absent; artificial fill overlies undifferentiated sedimentary deposits at one location in the center of the landfill. In the center of the landfill, the artificial fill includes a zone characterized by construction and industrial debris and waste and domestic refuse. Borings along the shoreline indicate that the Qaf/Qbm interface is from 3 to 26 feet bgs.

Undifferentiated Upper Sand Deposits (Quus)

Undifferentiated upper sand deposits underlie artificial fill in several borings; the observed thickness ranged from 0.5 to 63 feet. It may have been deposited or dredged from the bay for fill. The origin of the upper sand materials cannot be determined from soil samples collected during drilling.

Bay Mud Deposits (Qbm)

Bay Mud deposits were encountered in many borings completed to depths greater than 21.5 feet. Bay Mud deposits underlie both artificial fill and undifferentiated upper sand deposits; the top surface was observed at depths ranging from 2.5 to 57 feet bgs. This top surface is very uneven, perhaps in part because of loading pressure from the artificial fill and subsequent deformation of the Bay Mud. In general, Bay Muds are known to be absent in the northwest corner of Site IR-1/21; in other areas, Bay Mud thicknesses ranges from 3.5 to 56 feet. Along the shoreline, the top of Bay Mud ranges from 3 to 26 feet bgs.

Undifferentiated Sedimentary Deposits (Qu)

Undifferentiated sedimentary deposits were encountered in several borings. Undifferentiated sedimentary deposits underlie the artificial fill, undifferentiated upper sand deposits, and Bay Mud deposits; the top surface was observed at depths ranging from 24 to 62 feet bgs. Several borings were advanced through the undifferentiated sedimentary deposits into bedrock; the thickness ranged from 34 to 211 feet.

Franciscan Bedrock (Sp, KJsk)

Bedrock was encountered in few borings; bedrock underlies the undifferentiated sedimentary deposits and was observed at depths ranging from 62 to 269 feet bgs.

2.4.3 Hydrogeology

Both the A- and B-aquifers were encountered at Site IR-1/21. A-aquifer characteristics are summarized as follows:

- Consists of saturated artificial fill and, to a lesser extent, undifferentiated upper sand deposits

- The top of the A-aquifer is defined by the groundwater table, which is generally 4 to 12 feet bgs, but ranges to as much as 17 feet bgs in the center of Site IR-1/21. The bottom of the aquifer is defined by the upper surface of Bay Mud deposits.
- Saturated thickness ranges from 0 to approximately 42 feet
- Generally unconfined

The saturated portions of the A-aquifer are generally unconfined but may be locally confined where fine-grained fill materials overlie coarser-grained fill materials or undifferentiated upper sands. In the northwest corner of Site IR-1/21, where the Bay Mud is absent, the A-aquifer is in direct connection with the B-aquifer.

B-aquifer characteristics are summarized as follows:

- Consists of undifferentiated sedimentary deposits
- The top of the B-aquifer is defined by the bottom surface of the Bay Mud deposits; its bottom is defined by the upper surface of the Franciscan Complex bedrock
- Saturated thickness ranges from approximately 34 to 211 feet
- Generally semiconfined

Preliminary water-level elevations at the site have been interpreted from water levels in the A-aquifer (ranging from 18.06-2.21 feet bgs) and are presented in Appendix B. Groundwater flow conditions are summarized as follows:

- The groundwater flow direction in the A- and B-aquifers at Site IR-1/21 is radially outward to the east, southeast, and south from the northwest corner of the landfill.
- A-aquifer horizontal gradients calculated using February and July 1992 data ranged from approximately 0.002 to 0.017 foot per foot (ft/ft) across the site. B-aquifer gradients at IR-1/21 ranged from 0.001 to 0.003 ft/ft during the same time period.
- Tidal influence has been observed in a zone along the margin of the bay ranging in width from 200 to 600 feet. However, no change in the overall flow pattern is produced.
- Vertical gradients between the A- and B-aquifers were observed to be upward where wells monitoring both aquifers were present.

The heterogeneity in the A-aquifer in all of Parcel E provides a wide variation in hydraulic conductivities that slug test data indicate range from 0.003 to 250 feet per day (ft/day). Lateral variability of hydraulic conductivities is typically high in a landfill due to the unpredictable placement of various materials and subsequent compaction variability. Hydraulic data exist for two wells along the proposed alignment. Hydraulic conductivity was calculated by the Cooper Method from slug test data. Hydraulic conductivity for well IR01MW-3 was calculated to be 2.7 ft/day, and for well IR01MW43A, 7.7 ft/day.

Only two slug tests have been conducted along the 600 foot distance of the proposed alignment. There are no multiple well pumping test data, no time drawdown data, no storage coefficient data, no three-dimensional hydraulic conductivity data, and only widely spaced data on the saturated thickness of the A-aquifer.

2.5 PREVIOUS HPS REMOVAL ACTIVITIES

Previous removal activities provide information about feasible technologies, available equipment, and lessons learned that are valuable to this EE/CA. Previous removal activities conducted at HPS include (1) PCB cleanup at Site IR-8, (2) Tank S-505 Removal Action, (3) underground storage tank (UST) removals, (4) sandblast grit fixation, (5) Site IR-6 Tank Farm Removal Action, and (6) Pickling and Plating Yard Removal Action (ongoing). PCB-contaminated soils were discovered at Site IR-8, excavated, and disposed of off site. Tank S-505 was decontaminated and demolished, and some of the affected soil beneath it was excavated and disposed of off site. Under several different phases, numerous USTs have been removed or closed in place at HPS. Approximately 160 tons of soil associated with the USTs was excavated and disposed of at a Class I landfill in California. Under the sandblast grit fixation program, approximately 4,500 tons of sandblast grit was collected from areas throughout HPS and sent to an off-site recycling facility. The recycled sandblast grit was used as aggregate in asphaltic concrete (PRC 1995a). The Site IR-06 Tank Farm consisted of 10 aboveground fuel and lube oil tanks, piping, two pump houses, and associated equipment. All tanks, piping, and steel at the tank farm were decontaminated and salvaged. Approximately 140 cubic yards of soil were excavated to remove underground piping. The Pickling and Plate Yard Removal Action is ongoing and consists of decontamination of all surfaces and removal of hazardous material.

2.6 PREVIOUS SITE IR-1/21 INVESTIGATIONS

Site IR-1/21 was previously investigated by EMCON Associates to evaluate areas of potential soil and groundwater contamination identified in the initial assessment study (IAS) (EMCON 1987). EMCON drilled nine borings and completed all as monitoring wells at Site IR-1/21. Total depths of the borings and wells ranged from 11.5 to 34.5 feet. Soil and groundwater samples were analyzed for VOCs, polynuclear aromatic hydrocarbons (PAHs), and metals; the groundwater samples were also analyzed for phenols and gross alpha and beta radiation.

At Site IR-1/21, EMCON observed VOCs, PAHs, and metals in soil samples from five of the borings. In several of the borings, concentrations appeared to increase with depth. Low levels of VOCs, PAHs, metals, and phenols were detected in the IR-1/21 groundwater samples.

Based on the results of EMCON's investigation, Site IR-1/21 was included in the RI/FS program. The OU1 RI field work was completed in three phases and included drilling, well installation, trenching, and surface soil sampling.

The reconnaissance phase (Phase I), completed in February 1989, consisted of drilling six borings to bedrock at Site IR-1/21. Additionally, geophysical investigations were performed and seven test pits excavated to identify the boundaries of the landfill. A surface scintillation survey of Site IR-1/21 was conducted to evaluate gamma and beta radiation and a soil gas survey was performed to evaluate the potential presence of VOCs in the soil and groundwater. Results of the Phase I investigation were presented in the reconnaissance activities report (HLA 1990). No soil or groundwater samples were collected for chemical analysis.

The primary phase (Phase II) was subdivided into four subphases. Phase IIA was conducted from October 1990 to December 1990. Phase IIB.I was conducted from March 1991 to July 1991, Phase IIB.2 was conducted from December 1991 to January 1992, and Phase IIB.3 was conducted from April 1992 to May 1992. The results of the Phase IIA investigation were presented in the OU1 primary phase IIA data submittal (HLA 1991). Finally, the contingency phase (Phase III) was completed in August 1992.

During the three phases of the RI field program, 25 test pits were excavated; 56 borings were drilled, 20 of which were completed as monitoring wells; and 34 surface soil/intertidal sediment samples were collected. Approximately 113 groundwater samples were collected during six rounds of sampling.

Analyses included VOCs, SVOCs, TPH as gasoline and diesel, pesticides, PCBs, and metals. Figure 3 shows the locations of soil borings, monitoring wells, and test pits at Site IR-1/21. Results from all phases of the RI conducted a Site IR-1/21 will be documented in the Parcel E RI report to be completed in April 1997.

2.7 SOURCE, NATURE, AND EXTENT OF CONTAMINATION

This EE/CA has been prepared to address groundwater contamination migrating toward San Francisco Bay. Therefore, discussions in this section focus on groundwater contamination detected in samples from groundwater monitoring wells at Site IR-1/21 and in wells nearest San Francisco Bay. A brief discussion about the source of the groundwater contamination is presented first in Section 2.7.1. Section 2.7.2 discusses groundwater contamination plume concentrations at Site IR-1/21 and near the bay. All chemical contaminants are presented to give an overview of the contaminant profile; however, the removal action will focus on those chemical contaminants that pose a potential risk to human health and the environment.

2.7.1 Sources of Contamination

This section summarizes the analytical results for soil samples collected during RI activities. Organic chemicals including VOCs, SVOCs including total carcinogenic and noncarcinogenic PAHs, total oil and grease (TOG), TPH as gasoline and diesel, PCBs, pesticides, and metals were detected sporadically in samples from the artificial fill.

Frequency of detection and maximum and mean soil chemical concentrations were used to assist in identifying sources of contamination. Preliminary results are presented in Appendix C. Organic compounds and metals were primarily observed in Site IR-1/21 soils in both the debris zone (shown in Appendix A) and the surrounding artificial fill. Nearly all of the areas with elevated concentrations are found in the debris zone or artificial fill overlying the Bay Mud deposits. In a few instances, elevated concentrations were observed in the top few feet of Bay Mud or upper undifferentiated sands underlying the artificial fill. No contaminants were observed in the native deposits underlying the Bay Mud. Maximum concentrations in the debris zone were as follows:

- Xylenes: 519 milligrams per kilogram (mg/kg) at boring IR01B011
- Ethylbenzene: 55.7 mg/kg at boring IR01B011
- Aroclor 1260: 370 mg/kg from boring at monitoring well IR01MW05A

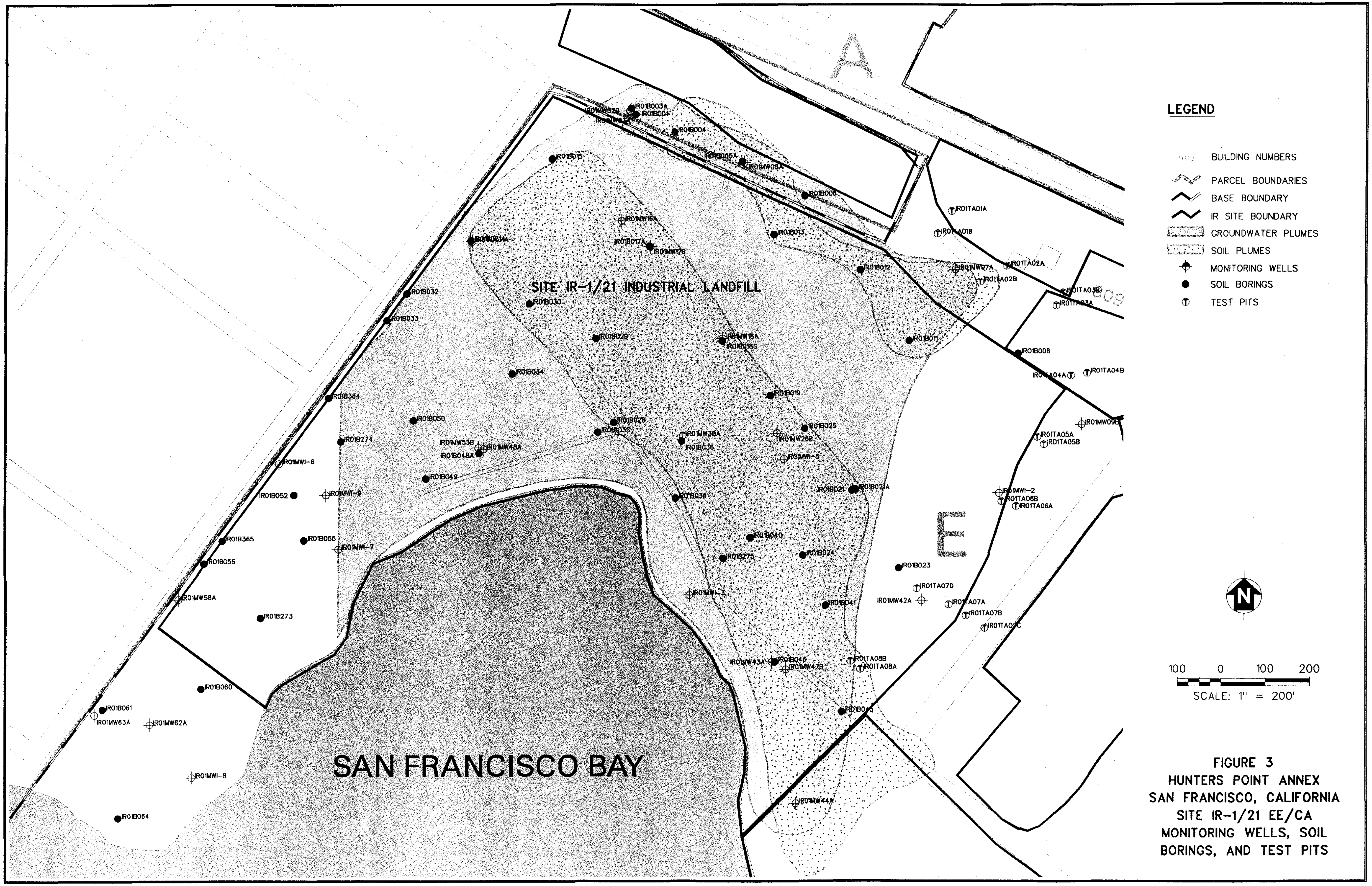

FIGURE 3
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
SITE IR-1/21 EE/CA
MONITORING WELLS, SOIL
BORINGS, AND TEST PITS

- TPH (diesel): 11,000 mg/kg at boring IR01B011
- TPH (gasoline): 9,200 mg/kg at boring IR01B011
- TOG: 300,000 mg/kg at boring IR01B006
- PAHs: 234 mg/kg at boring IR01B021A
- Arsenic: 49 mg/kg from boring at monitoring well IR01MW16A
- Copper: 175,000 mg/kg at boring IR01B021A
- Lead: 14,500 mg/kg from boring at monitoring well IR01MW26B
- Zinc: 15,800 mg/kg at boring IR01B018G.

Because of the extreme heterogeneity of the debris zone, there is no vertical or lateral consistency or pattern to the distribution of these compounds. However, because high concentrations are common, the entire debris zone is considered a source.

There were three other areas with detected concentrations of the above-listed compounds. Along the southwest boundary of the site, TPH as diesel up to 2,800 mg/kg and carcinogenic PAHs up to 14.7 mg/kg were observed in deep soil between approximately 4 and 18 feet bgs. Maximum concentrations of arsenic (315 mg/kg), copper (4,190 mg/kg), lead (4,740 mg/kg), and zinc (116,000 mg/kg) were found in this zone. This depth interval corresponds to the lower portion of artificial fill in this area.

Along the east and southeast sides of the landfill, detected concentrations of Aroclor 1260, TPH as diesel and gasoline, carcinogenic PAHs, copper, lead, and zinc were observed to a depth of approximately 5 feet bgs. This boundary of Site IR-1/21 is adjacent to Sites IR-4 and IR-12, where similar contamination has been observed.

In the west-central portion of the site adjacent to the bay, the RI identified potential landfill-related copper, lead, and zinc. The highest concentrations generally occurred in soil samples collected shallower than 6 feet bgs, but some concentrations were observed to a depth of 15 feet. Triple A reportedly disposed of sandblast waste in this area and sandblast material noted in boring logs appears to correlate closely with the areas associated with potential source-related metals.

2.7.2 Groundwater Contamination

This section summarizes analytical results for groundwater samples collected during RI activities. First, an overview of the Site IR-1/21 regional groundwater contamination plume is provided. Next, discussions focus on contamination detected in seven monitoring wells along the San Francisco Bay shoreline.

2.7.2.1 Site IR-1/21 Regional Plume

This section summarizes the analytical results for groundwater samples collected during RI activities. VOCs, SVOCs, PCBs, TPH compounds, pesticides, and metals have been detected in groundwater samples at Site IR-1/21. Organic compounds were chiefly found in the debris zone portion of the site (see Appendix A). Similar contamination was also observed along the southwestern boundary of the site. Table 1 presents a summary of organic chemicals detected during the RI. Consistently detected organic compounds are summarized below:

- Benzene and 1,4-dichlorobenzene were detected in samples from 10 wells
- Aroclor 1260 was detected in samples from six wells

Many metals including aluminum, arsenic, barium, cadmium, chromium, copper, lead, mercury, selenium, and silver were detected in samples at Site IR-1/21. Table 2 summarizes inorganic concentration levels found in groundwater samples collected during the RI. A large number of metals were detected in many wells during the RI; however, most of these detections occurred during only one sampling round. Concentrations of metals in approximately one-half of the samples collected during the July 1992 sampling event were anomalously high when compared with concentrations observed during previous and subsequent sampling events. For example, lead was detected in a sample from well IR01MWI-9 at a concentration of 6,520 micrograms per liter (μg/L) during the July 1992 event. This well was sampled during three additional sampling events and had only one detection of 1.2 μg/L. After thorough review of all field notes and forms, laboratory reports and disks, and the data, it was decided that filters used for samples collected for metals analysis were defective or of substandard quality. Additionally, eight of the wells sampled during the OU1 round in August 1992 had similarly elevated levels of metals. The effected July and August 1992 results are considered anomalous and are not discussed further in this report.

TABLE 1

HUNTERS POINT ANNEX SITE IR-1/21
SUMMARY OF ORGANIC GROUNDWATER DATA
FROM THE SITE IR-1/21 RI

Analyte	Number of Samples Analyzed	Number of Detections	Minimum Concentration (µg/L)	Maximum Concentration (µg/L)	Location of Maximum Concentration
Contract Laboratory Program (CLP) Volatile Organic Compounds					
Chloroethane	113	1	10	10	IR01MW43A
Methylene chloride	113	4	1.8	3	IR01MW62A
Acetone	113	9	24.7	66	IR01MWI-8
Carbon disulfide	113	16	1	8	IR01MWI-7
1,1-Dichloroethane	113	1	12	12	IR01MW43A
Chloroform	113	4	1.1	4.4	IR01MW53B
Carbon tetrachloride	113	1	3	3	IR01MWI-7
Benzene	113	44	1	44	IR01MW38A
2-Hexanone	113	2	2	3	IR01MWI-5
Tetrachloroethene	113	3	1	6	IR01MW31A
Toluene	113	17	1	7	IR01MW18A
Chlorobenzene	113	29	1	17	IR01MWI-5
Ethylbenzene	113	22	1	25	IR01MW58A
Xylenes	113	37	1	170	IR01MW43A
CLP Semivolatile Organic Compounds					
Phenol	113	17	2	67	IR01MW43A
1,3-Dichlorobenzene	113	4	6	13	IR01MW43A
2-Methylphenol	113	1	7.7	7.7	IR01MW43A
4-Methylphenol	113	18	2	34.81	IR01MW05A
2,4-Dimethylphenol	113	7	2	27.3	IR01MW05A
Benzoic acid	113	4	2	21.59	IR01MW16A
Naphthalene	113	38	2	190	IR01MW58A
4-Chloro-3-methylphenol	113	1	14	14	IR01MW43A
2-Methylnaphthalene	113	24	2	24	IR01MW18A
Acenaphthylene	113	1	2	2	IR01MW62A
Acenaphthene	113	22	2	29.11	IR01MW18A
Dibenzofuran	113	17	2	16.68	IR01MW18A
Fluorene	113	23	2	17.91	IR01MW18A
n-Nitrosodiphenylamine	113	3	2	6	IR01MW05A
Phenanthrene	113	24	2	39	IR01MWI-5
Anthracene	113	3	2	3	IR01MW62A
Fluoranthene	113	17	2	13	IR01MWI-3

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TABLE 1 (Continued)

HUNTERS POINT ANNEX SITE IR-1/21
SUMMARY ORGANIC GROUNDWATER DATA
FROM THE SITE IR-1/21 RI

Analyte	Number of Samples Analyzed	Number of Detections	Minimum Concentration (μg/L)	Maximum Concentration (μg/L)	Location of Maximum Concentration
Pyrene	113	17	2	15	IR01MWI-5
CLP Semivolatile Organic Compounds (Continued)					
Butylbenzylphthalate	113	1	2	2	IR01MW03A
Benzo(a)anthracene	113	5	2	5	IR01MWI-3
Chrysene	113	8	2	10	IR01MW43A
Bis(2-ethylhexyl)phthalate	113	6	2.5	160	IR01MW17B
Di-n-octylphthalate	113	1	3	3	IR01MW44A
Benzo(b)fluoranthene	113	5	2	6	IR01MWI-3
Benzo(a)pyrene	113	5	2	3	IR01MWI-3
Indeno(1,2,3-cd)pyrene	113	1	3	3	IR01MWI-5
Benzo(g,h,i)perylene	113	1	3	3	IR01MWI-3
CLP Pesticides\Polychlorinated Biphenyls					
Heptachlor	116	1	0.46	0.46	IR01MWI-5
Aroclor-1242	116	10	1.5	52	IR01MW16A
Aroclor-1254	116	4	1.4	8.1	IR01MW18A
Aroclor-1260	116	26	0.34	54	IR01MWI-3
Total Petroleum Hydrocarbons (TPH) as Diesel					
TPH-diesel	113	16	380	5,200	IR01MW43A
TPH-extractable unknown hydrocarbon	46	26	50	5,800	IR01MWI-3
TPH as Gasoline					
TPH-gasoline	113	3	120	1,100	IR01MW43A
TPH-purgeable unknown hydrocarbon	22	1	500	500	IR01MWI-5

Note:

μg/L   micrograms per liter

TABLE 2

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
SUMMARY OF INORGANIC GROUNDWATER DATA
FROM THE SITE IR-1/21 RI

Analyte	Number of Samples Analyzed	Number of Samples With Detected Analyte	Range of Detected Concentrations (µg/L)		Location of Maximum Concentration
			Minimum	Maximum	
Contract Laboratory Program (CLP) Atomic Absorption (Cold Vapor)					
Mercury	113	14	0.2	10	IR01MWI-9
CLP Atomic Absorption (Furnace)					
Antimony	8	2	22.8	22.8	IR01MW05A
Arsenic	113	75	1.1	77.8	IR01MWI-2
Lead	111	29	0.9	6,520	IR01MWI-2
Selenium	113	5	3	5.65	IR01MW05A
CLP Inductively Coupled Plasma					
Aluminum	113	25	15.33	183,000	IR01MWI-2
Antimony	105	22	19.58	286	IR01MW05A
Barium	113	113	15.7	7,480	IR01MW62A
Beryllium	113	18	0.27	5.1	IR01MWI-2
Cadmium	113	8	2.8	20.2	IR01MW05A
Calcium	113	113	6,760	461,000	IR01MWI-8
Chromium	113	58	2.4	2,750	IR01MWI-2
Cobalt	113	30	4.32	529	IR01MWI-2
Copper	113	35	1.7	1,780	IR01MWI-5
Iron	113	82	14.4	333,000	IR01MWI-2
Lead	2	2	358	3,740	IR01MW62A
Magnesium	113	113	17,400	1,130,000	IR01MWI-8
Manganese	113	113	31.4	9,700	IR01MWI-2
Molybdenum	112	23	5.7	37.2	IR01MW62A
Nickel	113	58	15.3	6,260	IR01MWI-2
Potassium	113	113	1,600	382,000	IR01MWI-8
Sodium	113	113	76,600	10,700,000	IR01MWI-8
Vanadium	113	58	1.9	553	IR01MWI-2
Zinc	113	49	5.5	5,050	IR01MW62A
CLP Cyanide					
Cyanide	101	16	0.01	23	IR01MW62A
EPA Test Method 7196					

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TABLE 2 (Continued)

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
SUMMARY OF INORGANIC GROUNDWATER DATA
FROM THE SITE IR-1/21 RI

Analyte	Number of Samples Analyzed	Number of Samples With Detected Analyte	Range of Detected Concentrations (μg/L)		Location of Maximum Concentration
			Minimum	Maximum	
Chromium VI	113	1	130	130	IR01MW02B
EPA Test Method 300.0					
Sulfate	103	76	1,100	2,430,000	IR01MWI-8
Nitrate as Nitrogen	95	16	22.4	60	IR01MWI-2
Chloride	92	92	34,500	18,500,000	IR01MWI-8
EPA Test Method 353.2					
Nitrate as Nitrogen	6	5	170	22,400	IR01MW53B
EPA Test Method 9045					
pH	85	85	6.4	10.3	IR01MW26B
EPA Test Method 160.1					
Total Dissolved Solids	106	106	420,000	34,200,000	IR01MWI-2

In general, contaminants in groundwater are limited to the A-aquifer. The exception is in the north corner of the landfill, where the Bay Mud separating the A- and B-aquifers is absent. In the north corner, several organic compounds were found in B-aquifer well IR01MW02B, but at low concentrations. In the other B-aquifer wells, organic compounds were either below detection limits or not detected consistently. Impacts to San Francisco Bay from the B-aquifer appear to be insignificant. Contamination present in IR01MW02B would likely have no impact upon migration to the bay due to fate and transport, and mixing factors. Therefore, B aquifer contamination in wells near the bay (IR01MW53B and IR01MW47B) are not included as part of the removal action.

Benzene was also detected at concentrations ranging from 1 to 6 $\mu g/L$ in samples from three wells along the southwest boundary of the site. No benzene was observed in soil samples from these wells or elsewhere in this area. Because groundwater flow in this area is generally south or east toward the bay, this may indicate that benzene is migrating onto the facility.

2.7.2.2 Groundwater Contamination Near San Francisco Bay

This section focuses on seven monitoring wells along the bay shoreline. These wells were selected to provide the most accurate representation of groundwater chemistry near the bay. For this EE/CA, the groundwater contamination detected in samples from groundwater monitoring wells nearest San Francisco Bay is of greatest concern. Contaminants found in these seven wells pose the most immediate potential threat to human and ecological receptors in the bay, and are the focus of the containment action. Figure 4 shows the locations of these wells and Table 3 summarizes well distances to the bay and screen depths.

VOCs, SVOCs, TPHs, and PCBs have been detected consistently in samples from the seven wells near the bay. Appendix D provides all the detected concentrations in these seven wells. Table 4 lists organic chemicals detected more than once, the number of detections, and the maximum concentration detected. As shown in the table, PCBs, benzene, 1,4-dichlorobenzene, chlorobenzene, chrysene, naphthalene, and TPH have been detected the most frequently and are the most widespread in wells near the bay. The maximum PCB detection (Aroclor 1260) was 54 $\mu g/L$ in well IR01MW1-3. Benzene was detected in samples from four wells; the detection nearest to the shoreline was at 9 $\mu g/L$ in well IR01MWI-3. The maximum benzene concentration was 44 $\mu g/L$ in well IR01MW38A.

FIGURE 4
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
SITE IR-1/21 EE/CA
MONITORING WELLS NEAR
SAN FRANCISCO BAY

11/03/95 /data0/huntera/amts/byptp4.map PRR

TABLE 3

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
SITE IR-1/21 GROUNDWATER MONITORING WELLS NEAR SHORELINE

Monitoring Well Number	Approximate Distance to San Francisco Bay (feet)	Screened Interval (feet)	
		bgs	msl
IR01MW38A	180	7 to 20	4.51 to -8.49
IR01MW43A	115	5 to 22.5	5.17 to -12.33
IR01MW48A	125	5 to 18	4.03 to -8.97
IR01MWI-3	55	4 to 17	unknown
IR01MWI-7	85	3 to 13	unknown
IR01MW44A	130	4 to 8	2.59 to -1.41
IR01MWI-8	70	2 to 12	unknown

Notes:

bgs below ground surface
msl mean sea level

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TABLE 4

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
SUMMARY OF ORGANIC CONTAMINATION IN WELLS NEAR THE BAY

Organic Chemical	Number of Detections	Number of Wells	Maximum Concentration (μg/L)	Concentration Closest to the Bay (μg/L)
1,3-Dichlorobenzene	4	1	13	8 (115 feet)
1,4-Dichlorobenzene	8	2	16	7 (55 feet)
1,1-Dichloroethane	1	1	12	12 (115 feet)
2,4-Dimethylphenol	2	1	13	13 (115 feet)
2-Methylnaphthalene	4	1	8	8 (115 feet)
2-Methylphenol	1	1	7.7	7.7 (115 feet)
4-Chloro-3-Methylphenol	1	1	14	14 (115 feet)
4-Methylphenol	1	1	7.7	7.7 (115 feet)
Acetone	3	2	66	66 (70 feet)
Aroclor 1260	12	3	54	54 (55 feet)
Benzene	15	4	44	9 (55 feet)
Benzoic acid	2	2	5	5 (115 feet)
Bis(2-Ethylhexyl)phthalate	1	1	2.5	2.5 (130 feet)
Benzo(a)anthracene	3	1	5	5 (55 feet)
Benzo(a)pyrene	3	1	3	3 (55 feet)
Benzo(b)fluoranthene	3	1	6	6 (55 feet)
Benzo(g,h,i)perylene	1	1	3	3 (55 feet)
Carbon disulfide	2	2	8	1 (70 feet)
Chlorobenzene	7	4	13	13 (55 feet)
Chloroethane	1	1	10	10 (115 feet)
Chrysene	6	3	10	5 (55 feet)
Di-n-octylphthalate	1	1	3	3 (130 feet)
Ethylbenzene	4	2	10	10 (115 feet)
Fluoranthene	4	2	13	13 (55 feet)
Fluorene	4	4	3	3 (55 feet)
Indeno(1,2,3-CD)pyrene	1	1	3	3 (55 feet)
Methylene chloride	2	2	2	2 (85 feet)
Naphthalene	12	4	14	2 (55 feet)
4-Methyl-2-Pentanone	1	1	3.8	3.8 (130 feet)
Phenanthrene	3	2	4	2 (55 feet)
Phenol	10	3	67	6 (55 feet)

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TABLE 4 (Continued)

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
SUMMARY OF ORGANIC CONTAMINATION IN WELLS NEAR THE BAY

Organic Chemical	Number of Detections	Number of Wells	Maximum Concentration (µg/L)	Concentration Closest to the Bay (µg/L)
Pyrene	2	2	10	10 (55 feet)
Tetrachloroethylene	2	2	1.5	1 (55 feet)
Toluene	5	2	6	2 (85 feet)
TPH as diesel	4	3	5,200	5,200 (115 feet)
TPH extractable (unknown)	10	5	4,000	4,000 (55 feet)
Trichloroethene	1	1	1.1	1.1 (130 feet)
Xylene (total)	6	3	170	2 (55 feet)

Notes:

1. Only compounds detected more than once in any shoreline well are listed
2. Number of wells is out of the seven total shoreline wells

µg/L micrograms per liter

Table 5 summarizes the inorganic constituent concentrations detected in samples from seven wells nearest San Francisco Bay. The table provides average, maximum, and minimum concentrations. To evaluate whether inorganic constituent concentrations in groundwater are a result of Navy activities, an ambient or background concentration evaluation should be undertaken. This evaluation will be conducted in the ongoing RI/FS process. For this EE/CA, inorganic chemicals of concern (COCs) were evaluated using toxicity levels for human health and aquatic life. This evaluation is conducted in Section 2.8.3.

2.8 STREAMLINED RISK EVALUATION

This streamlined risk evaluation is limited in scope to provide justification for a removal action at Site IR-1/21. According to EPA guidance on conducting non-time critical removal actions, when "standards for one or more contaminants in a given medium are clearly exceeded, a removal action is generally warranted, and further quantitative assessment that considers all chemicals, their potential additive effects, or additivity of multiple exposure pathways, are generally not necessary" (EPA 1993).

This EE/CA has been prepared to address groundwater contamination originating from Site IR-1/21 and potentially migrating toward San Francisco Bay. Section 2.8.1 discusses the potential for human exposure to groundwater by discussing groundwater quality in the HPS area and the potential for future groundwater development. Section 2.8.2 discusses potential environmental impacts from groundwater contamination migrating toward the bay. Section 2.8.3 identifies chemicals of concern (COCs) and areas of concern.

2.8.1 Potential for Human Exposure to Groundwater

Groundwater and surface water at HPS are not used for domestic drinking water (NEESA 1984). The City and County of San Francisco supplies about 0.409 million gallons per day of surface water from the Sierra Nevada mountain range by the Hetch Hetchy distribution system to HPS for drinking and industrial uses (Pacific Group 1993). Additionally, there are no domestic water supply wells in the HPS area (DPH 1991). However, the Albion Mountain Spring Water Company, a water bottling and distribution facility on Innes Avenue, uses a spring that discharges water from the Franciscan bedrock less than 1 mile north of HPS (DPH 1991). During the Parcel A RI it was found that the bedrock aquifer consists of sporadic, discontinuous, localized fractures (PRC 1995b).

TABLE 5

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
SUMMARY OF INORGANIC CONTAMINATION IN WELLS NEAR THE BAY

Inorganic Chemical	Average Concentration (μg/L)	Maximum Concentration (μg/L)	Minimum Concentration (μg/L)
Aluminum	4,190	4,190	4,190
Antimony	37.92	49.10	22.8
Arsenic	6.07	22.5	1.1
Barium	570.5	1,880	56.8
Beryllium	1.25	2.9	0.32
Cadmium	2.8	2.8	2.8
Calcium	142,360	288,000	56,200
Chloride	3611.3	18,500	33.7
Chromium III	13.7	23.8	2.4
Cobalt	8.2	9.7	6.6
Copper	8.6	52.4	2.2
Cyanide	5.6	17	.02
Iron	1,823	5400	48
Lead	21.06	61.2	1
Magnesium	248,147	843,000	25,700
Manganese	623	1,510	80
Molybdenum	8.42	18.2	8.8
Nickel	44.2	87	21.3
Orthophosphate as P	1	3.2	1
Potassium	84,324	382,000	9,930
Selenium	25	25	25
Silver	1.9	1.9	1.9
Sodium	2,206,067	8,210,000	695,000
Sulfate	540,000	2,430,000	4,500
Total Dissolved Solids	7,789,520	34,200,000	695,000
Vanadium	9.1	24.7	3.2
Zinc	88.5	235	5.6

Notes:

1. Only compounds detected more than once in any shoreline well are listed.
2. Number of wells out of the seven total shoreline wells.
3. Metals concentrations based on analysis of filtered samples.

μg/L micrograms per liter
pCi/L picoCuries per liter

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San Francisco contains seven groundwater basins: two oceanside basins and five bayside basins (CH2M Hill 1993). Two of the bayside basins equally divide HPS: the Islais Valley Groundwater Basin on the northeast and the South Groundwater Basin on the southwest. The regional groundwater quality of the Islais Valley and South Groundwater Basins is generally unknown. The few wells developed in these basins produce water from drinking water quality to water below primary drinking water standards for nitrate and secondary drinking water standards for total dissolved solids (TDS). Well water samples from the Islais Valley Groundwater Basin were reportedly very hard, with more than 200 milligrams per liter (mg/L) TDS as $CaCO_3$, and as hard to very hard from the South Groundwater Basin. There is a moderate to high density of known toxic release sites in the Islais Valley and South Groundwater Basins, with the highest density of sites in the industrial area east of Highway 101 (CH2M Hill 1993). This industrial area covers artificial fill or Bay Mud deposits and is unlikely to be used for groundwater development.

The potential for future groundwater development in San Francisco is limited, but is most promising in the west side groundwater basins where there is thicker alluvium beneath residential, nonurbanized, and nonindustrial land uses. The bayside Islais Valley Groundwater Basin and South Groundwater Basin have an estimated total amount of groundwater available for development of less than 2,000 acre-feet per year (ac-ft/yr) and less than 700 ac-ft/yr, respectively (CH2M Hill 1993).

HPS aquifers are unlikely to be used as groundwater sources, since HPS is removed from the more potentially productive valley bottom of the Islais Valley to the west. HPS is dominated by bedrock, a thin alluvial aquifer, a Bay Mud deposit aquitard, and artificial fill. At Site IR-1/21, the artificial fill (with portions of the debris zone [shown in Appendix A] below the water table) is extremely unlikely to be developed as a water source. Additionally, HPS has relatively low freshwater recharge because of its high bedrock elevations compared to other areas. HPS also has a thin, tidally and salinity affected (seawater intrusion) alluvial aquifer, which is unlikely to attract or sustain groundwater development. A more readily accessible and higher quality water is available through the Hetch Hetchy distribution system.

Human exposure through the ingestion of groundwater is a highly unlikely pathway. Therefore, this exposure pathway is considered incomplete. However, human exposure through the ingestion of fish and other aquatic life contaminated with hazardous substances is a potential pathway.

Humans could also be exposed to some organic chemicals via inhalation if the chemicals volatilized and migrated into basements, or via dermal contact if the chemicals migrated into San Francisco Bay. The inhalation pathway does not appear to be complete based on available data. The dermal contact exposure pathway will be further evaluated as part of the RI/FS process, but will not be evaluated as part of this EE/CA.

Screening criteria, COCs, and associated areas of concern are identified in Section 2.8.3.

2.8.2 Potential Environmental Impacts

Environmental impacts could occur if groundwater contamination migrates into San Francisco Bay. Aquatic life living in the bay could be exposed to toxic constituents in the groundwater. This pathway is likely to be complete because data indicate the A-aquifer is hydraulically connected to the bay water.

Screening criteria, COCs, and associated areas of concern are identified in Section 2.8.3.

2.8.3 Chemicals of Concern and Areas of Concern

Identifying COCs and target areas for a removal action is a subjective decision process that involves professional judgement. The guidance for removal actions (EPA 1993) indicates that magnitude of threat is an important factor for determining the need for a removal action. The Navy believes that groundwater removal actions at HPS should be undertaken only at areas that present a high magnitude of threat to current receptors or areas that the Navy feels confident that an action would be recommended following an RI/FS evaluation. (The ongoing RI/FS process will provide a thorough evaluation of site-specific conditions that impact both current and future receptors and quantify potential threats.)

The approach initially proposed by the Navy to identify groundwater that poses a high threat to surface water, and thus, groundwater that warrants a removal action involved (1) dividing the highest groundwater concentrations detected in the wells closest to the bay by a factor of 10 to account for migration and dilution factors, and (2) comparing those levels to the most stringent of ambient water quality criteria (EPA 1988) and basin plan objectives (RWQCB 1995) for protection of aquatic life. The regulatory agencies recommended a more conservative approach, specifically, using water quality objectives for protection of human health and aquatic life given in the enclosed bay and estuary plan (SWRCB 1993) to screen the groundwater analytical data. It should be noted that the enclosed bay and estuary plan has not been adopted by the State of California to date. The Navy is documenting this initial approach to show that a range of approaches were considered.

To ensure that the broadest possible range of potential contaminants and areas of concern were considered, the Navy has agreed to us the water board's suggestion to use the bay and estuary plan objectives for screening. The Navy proposes that this screening criteria be used in conjunction with evaluating the magnitude and number of times a contaminant is detected in a monitoring well to identify areas of concern. During the RI/FS, the Navy will develop site-specific risk assessments and cleanup goals for use in directing final remediation.

The Navy is concerned that using stringent published toxicity values to identify areas warranting a removal action may lead to removal action recommendations in areas that would yield no action decisions after site-specific risk and fate and transport evaluations are completed. The bay and estuary plan includes provisions for fate and transport evaluations, mass loading allocations, ambient level considerations, mixing zone calculations, and economic feasibility evaluations. These considerations are not integrated into the objectives presented in the plan and are not analyzed further herein because this analysis is beyond the scope of this EE/CA. Site-specific background and fate and transport evaluations will influence the threat evaluations. Therefore, the Navy believes it may not be appropriate to use bay and estuary objectives alone to trigger groundwater removal actions at HPS.

Results of the comparison to the screening criteria are presented below. Figures 5 and 6 list the organic and inorganic constituents that have detections above screening levels and show the maximum detections above screening levels at each of the Site IR-1/21 wells. To meet the objectives of this EE/CA, the groundwater contamination detected in samples from groundwater monitoring wells nearest San Francisco Bay is the area of the most immediate concern. Therefore, the remainder of this report focuses on seven monitoring wells along the bay shoreline (see Section 2.7.2.2 and Table 3).

Organic Chemicals

Table 6 identifies chemicals that exceed screening levels and compares maximum groundwater organic chemical concentrations to the screening criteria. This table shows that PCBs (Aroclor-1260), benzene, and PAHs [benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene,

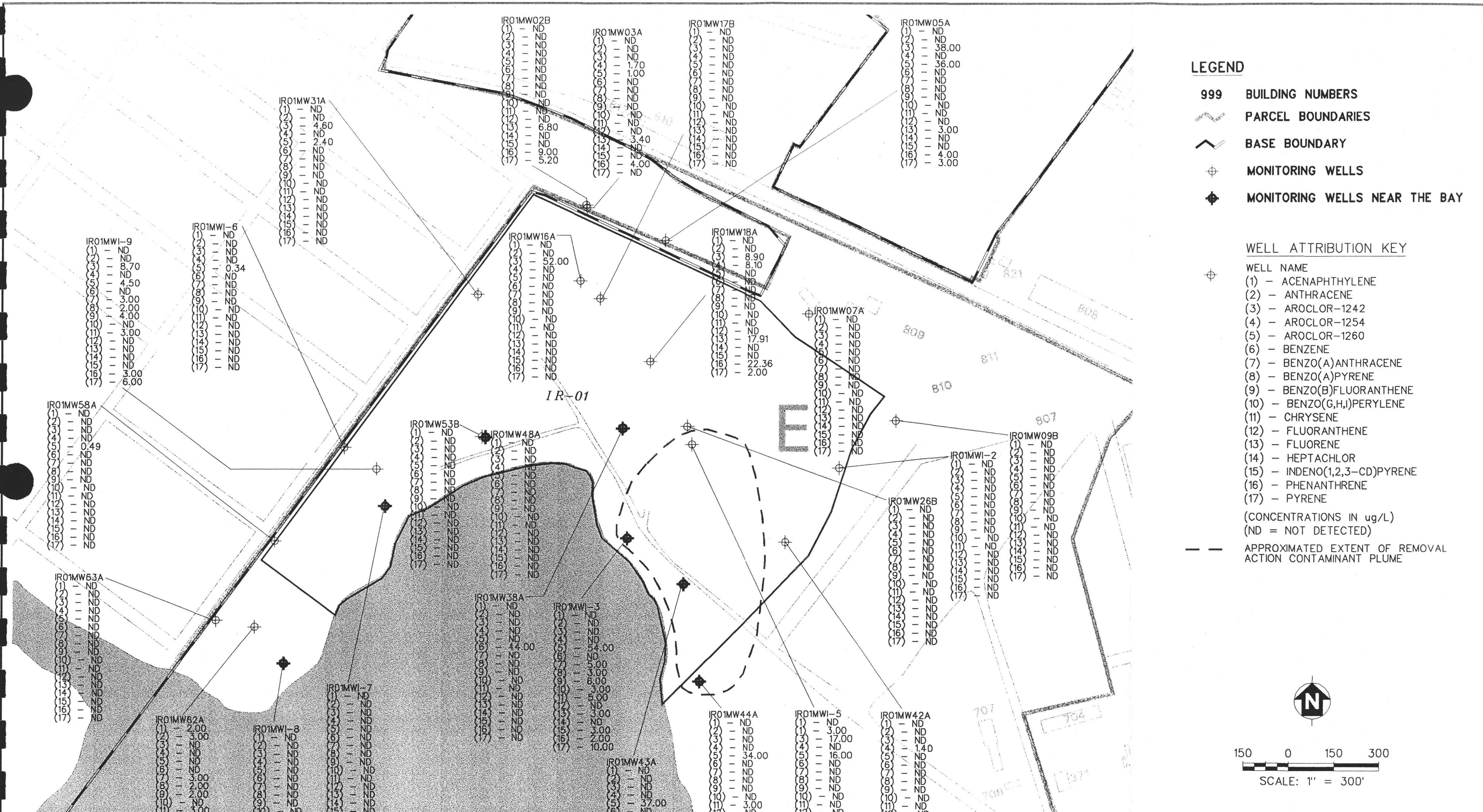

FIGURE 5
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
PARCEL E EE/CA
MAXIMUM ORGANIC CONCENTRATIONS
ABOVE SCREENING LEVELS

FIGURE 6
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
PARCEL E EE/CA
MAXIMUM INORGANIC CONCENTRATIONS
ABOVE SCREENING LEVELS

TABLE 6

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COMPARISON OF ORGANIC CONTAMINATION IN WELLS NEAREST THE BAY TO SCREENING CRITERIA

Organic Chemical[1]	Bay and Estuary Plan Human Health[2] (μg/L)	Bay and Estuary Plan Aquatic Life[2] (μg/L)	Maximum Concentration (μg/L)	Concentration Closest to the Bay (μg/L)
1,3-Dichlorobenzene	2,600	--	13	8 (115 feet)
1,4-Dichlorobenzene	64	--	16	7 (50 feet)
Aroclor-1260	0.00007	0.03	54	54 (50 feet)
Benzene	21	--	44	9 (50 feet)
Benzo(a)anthracene	0.013	--	5	5 (55 feet)
Benzo(a)pyrene	0.013	--	3	3 (55 feet)
Benzo(b)fluoranthene	0.013	--	6	6 (55 feet)
Benzo(g,h,i)perylene	0.013	--	3	3 (55 feet)
Chrysene	0.013	--	10	5 (50 feet)
Ethylbenzene	29,000	--	10	10 (115 feet)
Fluoranthene	42	--	13	13 (50 feet)
Fluorene	0.013	--	17.91	3 (55 feet)
Indeno(1,2,3-C,D)pyrene	0.013	--	3	3 (55 feet)
Methylene chloride	1,600	--	2	2 (85 feet)
Phenanthrene	0.031	--	4	2 (50 feet)
Phenol	4,600,000	--	67	6 (50 feet)
Pyrene	0.031	--	10	10 (50 feet)
Tetrachloroethylene	6.9	--	1.5	1 (50 feet)
Toluene	300,000	--	6	2 (85 feet)
Trichloroethylene	92	--	3	3 (130 feet)

Notes:

1 Only compounds detected more than once in samples from any shoreline well are listed in the table and only compounds that have Bay and Estuary Plan screening data are shown.

2 The most stringent of water quality objectives for protection of human health and aquatic life in the Enclosed Bay and Estuary Plan (SWRCB 1993). The human health numbers are based on consumption of fish and do not make a distinction between fresh and salt water. The aquatic life values are salt water objectives.

μg/L micrograms per liter

-- Data not available

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benzo(g,h,i)perylene, indeno(1,2,3-C,D)pyrene, chrysene, fluorene, phenanthrene, and pyrene] are present in wells near the bay at levels that exceed screening levels. Figure 5 shows the locations of these groundwater monitoring wells. Only PCBs are present in wells at levels that consistently exceed screening levels.

The maximum PCB detection is 54 μg/L and compares to a screening level of 0.00007 μg/L. PCBs (Aroclor-1260) have been detected in three wells near the bay above screening criteria:

- IR01MWI-3 (detected four times, 54 μg/L maximum)
- IR01MW43A (detected two times, 37 μg/L maximum)
- IR01MW44A (detected five times, 34 μg/L maximum)

Based on soil samples collected from well location IR01MW43A, it appears that PCBs are present in the overlying soils at this location. PCBs were detected at 20,000 micrograms per kilogram (μg/kg) at 1.25 feet bgs and 8,200 μg/kg at 3.75 feet bgs. These soils could be the source of PCB contamination found in monitoring well IR01MW43A. Soil sample results are not available from well IR01MWI-3; however, site maps contained in Appendix A show that monitoring well IR01MWI-3 is located just downgradient of the debris zone. The borelog shows that well IR01MWI-3 is screened through traces of refuse, indicating it may actually be located in the outer fringe of the landfill. Since landfill refuse is extremely heterogeneous, the source of PCBs detected in IR01MWI-3 is likely the nearby refuse. Well IR01MW44A is located in Site IR-2. Therefore, it is not known whether the PCBs detected in samples from well IR01MW44A originate from Site IR-2 or Site IR-1/21.

Typically, PCBs exhibit very low solubility in groundwater and are usually immobile. However, at locations near wells IR01MWI-3, IR01MW43A, and IR01MW44A, hydrogeologic conditions may be favorable for contaminant migration. Monitoring well IR01MWI-3 was completed through 10 feet of saturated sand and gravel sediments. Monitoring well IR01MW43A, which is 190 feet southeast of well IR01MWI-3, was completed through 9 feet of saturated sand sediments. Monitoring well IR01MW44A, which is 330 feet southeast of IR01MW43A, was completed through 2 feet of saturated sand sediments. The borelogs from Site IR-1/21 borings are contained in Appendix E. As stated above, PCBs generally exhibit very low solubility in groundwater. However, PCB cosolvency with VOCs in groundwater can accelerate PCB migration in groundwater.

All the PAHs detected above screening levels are also found in groundwater monitoring wells IR01MWI-3, IR01MW43A, and IR01MW44A. The following PAHs were detected in monitoring well IR01MWI-3:

- Benzo(a)anthracene (detected three times, maximum detection 5 μg/L)
- Benzo(a)pyrene (detected three times, maximum detection 3 μg/L)
- Benzo(b)fluoranthene (detected three times, maximum detection 6 μg/L)
- Benzo(g,h,i)perylene (detected once, maximum detection 3 μg/L)
- Indeno(1,2,3-CD)pyrene (detected once, maximum detection 3 μg/L)
- Chrysene (detected three times, maximum detection 5 μg/L)
- Fluorene (detected twice, maximum detection 3 μg/L)
- Phenanthrene (detected twice, maximum detection 2 μg/L)
- Pyrene (detected three times, maximum detection 10 μg/L)
- Fluoranthene (detected three times, maximum detection 13 μg/L)

The following PAHs were detected in monitoring well IR01MW43A:

- Chrysene (detected twice, maximum detection 10 μg/L)
- Fluorene (detected twice, maximum detection 2 μg/L)
- Phenanthrene (detected twice, maximum detection 4 μg/L)
- Pyrene (detected once, maximum detection 3.4 μg/L)
- Fluoranthene (detected once, maximum detection 3.4 μg/L)

The following PAHs were detected in monitoring well IR01MW44A:

- Chrysene (detected once, maximum detection 3 μg/L).

Benzene was detected once above the screening level in monitoring well IR01MW38A at a concentration of 44 μg/L, but the detection appears to be an isolated incident. Benzene was detected two other times in this well at a concentration of 1 μg/L which is below screening levels. This monitoring well is located 180 feet from the shoreline. Benzene detected in this well may not pose an immediate threat to human health or the environment.

Because benzene was only detected once above screening levels, it is not considered a COC. Figure 5 depicts an estimated boundary for the plume of organic contaminants with levels that exceed the screening criteria.

It appears that most of the PCB and PAH detections above the screening criteria are in the southeast corner near the bay. PCBs were detected in 11 out of the 18 monitoring wells installed in the landfill (see Figure 5). PCBs were detected in 3 out of the 7 wells near the bay. PAHs were detected in 6 out of 18 wells above screening levels. PCBs in monitoring wells IR01MWI-5, IR01MWI-3, IR01MW43A, IR01MW47B, and IR01MW44A have consistent detections of PCBs well above the screening criteria. The majority of PAHs detected above screening levels are also from these wells. Therefore, this is an area of concern that warrants a removal action.

No published criteria are available for comparison for several organic chemicals (2,4-dimethyl phenol, methyl naphthalene, 4-methyl phenol, orthophosphate as P, TPH as diesel, and TPH extractable), which were detected more than once.

Inorganic Chemicals

Table 7 identifies chemicals that exceed screening levels and compares maximum groundwater inorganic chemical concentrations to the screening criteria. This table shows that detections of beryllium, copper, lead, nickel, silver, and zinc exceed the screening criteria.

Nickel and copper have been detected in monitoring wells IR01MWI-3, IR01MW38A, IR01MW43A, and IR01MW48A above screening levels. The maximum detection of nickel out of all four monitoring wells is 87 μg/L. The maximum detection of copper out of all four monitoring wells is 52.4 μg/L. Nickel and copper have been detected consistently across HPS, and the concentrations and locations appear to be attributable to background levels. The Navy is currently working with the regulatory agencies on a separate study to determine Hunters Point Groundwater Ambient Levels (HGALs). Serpentine bedrock, found below HPS, is a common source of nickel and is also associated with small deposits of copper (Prinz and others 1978). Based on these factors, nickel and copper will not be addressed in this removal action because a thorough evaluation of ambient levels is beyond the scope of this EE/CA. However, nickel and copper will be addressed in the RI/FS process.

TABLE 7

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COMPARISON OF INORGANIC CONTAMINATION IN WELLS NEAREST
THE BAY TO LEVELS SCREENING CRITERIA

Inorganic Chemical[1]	Bay and Estuary Plan Human Health[2] (μg/L)	Bay and Estuary Plan Human Health[2] (μg/L)	Average Concentration[3] (μg/L)	Maximum Concentration[3] (μg/L)
Antimony	4,300	--	29.5	38.6
Arsenic	--	36	7.6	22.5
Beryllium	0.13	--	1.25	2.9
Cadmium	--	9.3	2.8	2.8
Chromium III	670,000	--	13.7	23.8
Copper	--	2.9	8.6	52.4
Lead	--	5.6	61.2	61.2
Nickel	4,600	8.3	44.2	87
Selenium	--	71		
Silver	--	2.3	1.9	1.9
Zinc	--	86	88.5	235

Notes:

1 Only hazardous substances (defined in 40 CFR 302.4) identified more than once in samples from any shoreline well are listed in the table. It is inappropriate to base a removal action on one data point. Only compounds that have Bay and Estuary Plan screening data are shown.

2 The most stringent of water quality objectives for protection of human health and aquatic life in the Enclosed Bay and Estuary Plan (SWRCB 1993). The human health numbers are based on consumption of fish and do not make a distinction between fresh and salt water. The aquatic life values are salt water objectives.

3 Metals concentrations are based on analysis of filtered samples.

-- Data not available

μg/L micrograms per liter

Beryllium was detected above screening levels in monitoring wells IR01MW38A, IR01MW44A, and IR01MWI-7. The maximum concentration was detected in monitoring well IR01MWI-7, at 2.9 μg/L. This well was sampled four times over two years, and beryllium was detected in one of the four samples. Beryllium was also detected one out of three times in monitoring well IR01MW38A, and two out of three times in monitoring well IR01MW44A. Beryllium may pose a potential threat to human health and the environment near well IR01MW44A.

Lead was detected above screening levels in monitoring well IR01MW48A at a maximum concentration of 61.2 μg/L. Lead was detected in three out of four samples from this well. The other two samples showed lead at a concentration of 1 μg/L which is below screening levels. Because lead was only detected once above screening levels, this metal is not considered a COC. It is inappropriate to base a removal action on one data point.

Silver was detected in one out of four samples from monitoring well IR01MW48A at 1.9 μg/L, which is above screening levels. Silver was not detected in any other wells near the bay. Because silver has been detected only once, this metal is not considered a COC. Again, it is inappropriate to base a removal action on one data point.

Zinc was detected above screening levels in monitoring well IR01MW43A, IR01MW44A, and IR01MW48A. The maximum zinc detection was in well IR01MW44A at 235 μg/L. Zinc was detected in one out of four samples from well IR01MW48A, four out of four samples from well IR01MW44A, and three out of four samples from well IR01MW43A. Based on these results, monitoring wells IR01MW43A and IR01MW44A may pose a threat, and therefore, a removal action is warranted.

Figure 6 shows the locations of inorganic detections above screening levels in monitoring wells.

<u>Summary</u>

The only inorganic chemicals consistently detected in the shoreline wells above screening levels are beryllium, nickel, copper, and zinc. Nickel and copper may be related to serpentine bedrock and are not considered further as part of this removal action. Nickel and copper will be addressed in the RI/FS process after HGALs have been established. Several organic chemicals (PAHs, PCBs, and benzene) were detected above screening levels in samples from wells near the bay. Only PCBs were detected consistently at concentrations well above screening levels. At the southeast boundary of the landfill, there are three wells near the bay with consistent PCB detections, wells IR01MW44A, IR01MW43A, IR01MWI-3. These three wells represent the target area for this removal action (see Figure 5 for the target plume area). These same wells had the PAH detections above screening levels; two of these wells (IR01MW44A and IR01MW43A) had consistent zinc detections above screening levels; and well IR0MW44A had consistent beryllium detections above the screening levels. The three wells are 250 to 300 feet apart. Since these data points are far apart and because PCBs, PAHs, beryllium, and zinc are typically not very mobile in groundwater, it is not known whether the PCBs, PAHs, and zinc are widespread along this 600-foot-long southeastern area. All data supporting the removal action should be confirmed since the last sampling was conducted in 1992. Therefore, confirmation data from these three wells were obtained in March 1996, and results indicate that PCB concentrations have decreased, but not below screening levels. CPT, as well as monitoring well and HydroPunch (HP) groundwater sampling, will be required to more fully determine lithology and the extent of groundwater contamination. The groundwater monitoring well sampling is currently ongoing. The CPTs and HP sampling will be predesign activities (referred to as Phase I) for this removal action. This EE/CA will evaluate removal alternatives assuming a contaminant profile as described above.

Additional Groundwater Analytical Results

Since the submittal of the draft EE/CA, additional groundwater sampling was conducted on March 19, 1996 for monitoring wells IR01MWI-3, IR01MW43A, and IR01MW44A. The data are presented in Appendix G. These data are unvalidated and should be considered preliminary. The results indicate PCB concentrations in these wells have decreased by one order of magnitude. Since the 1992 sampling event, nickel and zinc concentrations have increased. A summary of the most notable results is presented below.

	1992 (μg/L)			1996 (μg/L)		
Well	PCB	Zinc	Nickel	PCB	Zinc	Nickel
IR01MWI-3	54	19	28.4	2.2	323	315
IR01MW43A	32	36.1	Not detected	3.4	8.4	9.3
IR01MW44A	19	Not detected	Not detected	3.3	19	2.5

3.0 IDENTIFICATION OF REMOVAL ACTION OBJECTIVES

3.1 REMOVAL ACTION SCOPE

The scope of this removal action is contaminated groundwater containment. This action is not meant to be a final action for the groundwater at the site. The source of groundwater contamination will be addressed under subsequent remedial actions, as necessary. An RI/FS will be completed for this parcel to evaluate long-term remediation goals and strategies. This removal action addresses groundwater at areas that exhibit CERCLA hazardous substances consistently above screening levels.

Hazardous substances attributed to ambient conditions should not be considered under the scope of any removal action because ambient levels will not be eliminated through groundwater restoration activities. Some of the inorganic chemicals appear to be ubiquitous at HPS (for example, nickel exceeds screening levels at 123 out of 148 wells located within Parcels C, B, and E). Therefore, some inorganic compounds will not be considered at this time because a thorough evaluation of ambient levels is beyond the scope of this EE/CA. The ambient levels will be evaluated in the RI/FS process.

3.2 REMOVAL ACTION OBJECTIVES

The objective of this removal action is to protect human health and the environment from potential immediate threats posed by groundwater contamination. Threats to human health may result from exposure through ingestion of fish and other aquatic life. Threats to the environment may result from exposure to groundwater through migration into San Francisco Bay. The removal action is intended to advance the status of the groundwater contaminated areas toward remediation. The specific objective of this EE/CA report is to accomplish the following:

- Summarize and evaluate the current knowledge of the extent of contaminated groundwater at Site IR-1/21
- Identify and evaluate potential removal action alternatives
- Provide a basis for selecting a recommended removal action alternative
- Satisfy administrative record requirements for documenting the removal action alternative evaluation and recommendations

The overall goal of the Site IR-1/21 groundwater removal action is to reduce the risks to human health and the environment from the contaminated groundwater. The specific objective is the following:

- Prevent groundwater with contaminant levels detected consistently above screening criteria (see Sections 2.8.1 and 2.8.2) from migrating into San Francisco Bay.

A removal action that will be compatible with future remedial actions planned at HPS will be considered. Parcel E overall remediation has not yet been defined. The Navy has not begun the FS for Site IR-1/21. However, presumptive remedies for landfill closures consist of containing landfill contents and preventing migration of contamination.

3.3 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS

The NCP states that "removal actions. . . shall to the extent practicable considering the exigencies of the situation, attain applicable or relevant and appropriate requirements under federal environmental or state environmental or facility siting laws" (40 CFR Section 300.415[i]). This section provides an overview of potential ARARs and discusses the identification of ARARs and to be considered (TBC) guidance for Site IR-1/21 groundwater. Final ARARs will be presented in the action memorandum issued by the Navy for this removal action. The ARARs identified are for on-site actions. Off-site actions (such as, disposal of soil and discharges to the sanitary sewer) will comply with applicable requirements.

The purposes of this ARAR evaluation are to identify and evaluate potential federal and state ARARs and to set forth the Navy's determinations regarding those potential ARARs for each removal alternative addressed in the EE/CA for the Site IR-1/21 groundwater removal action.

3.3.1 Identification of ARARs

ARARs are generally divided into three categories: chemical-specific, location-specific, and action-specific. The sections below discuss federal and state ARARs that are potentially applicable to the Site IR-1/21 removal action. Table 8 summarizes potential location- and action-specific ARARs based on current site data. ARARs are discussed more specifically in Section 5.0 with respect to each alternative.

TABLE 8

HUNTERS POINT ANNEX
SITE IR-1/21 EE/CA
POTENTIAL LOCATION- AND ACTION-SPECIFIC ARARs

Regulation	Purpose/Requirement	Applicability to Removal Action	Citation
Endangered Species Act of 1973; California Fish and Game Code	These legislation requires action to conserve endangered or threatened species, including consultation with the Department of Interior.	These requirements are relevant and appropriate to the removal action because vegetation provides a suitable habitat for the salt marsh harvest mouse, which is classified as both a Federal and state endangered species.	16 USC 1536(a); Fish and Game Code 2014, 2080, and 1900 et seq., 2090 - 2096
Protection of Wetlands	This legislation requires action to minimize the destruction, loss, and degradation of wetlands.	Salt marsh habitats were identified along the bay margin at Site IR-1/21. Therefore, this requirement is an ARAR for any actions that may impact these areas.	40 CFR Part 6, Appendix A and Executive Order 11990 40 CFR 6.302
Coastal Zone Management Act; California Coastal Act of 1976	These legislation require that activities be conducted in a manner consistent with State management programs.	Site IR-1/21 is in a coastal zone. For any removal action involving discharge in the coastal zone, these requirements would be applicable.	Section 307(c) of 16 USC §§1451 et seq. 15 CFR 930 and 923.45; 14 CCR 13001-13600
Resource Conservation and Recovery Act (RCRA)	This legislation outlines the requirements for the transportation, storage, and disposal of defined hazardous wastes. The regulations include standards to accommodate treatment of hazardous wastes in corrective action management units and temporary treatment units. The state of California has an authorized RCRA program.	Some of the wastes that may be handled during any removal action at Site IR-1/21 may be hazardous wastes. The specific requirements that may be applicable will depend on the wastes handled and the technologies used.	22 CCR, Division 4.5
San Francisco Bay Area Air Quality Management District Rules and Regulations	These rules and regulations pertain to stationary sources of air emissions. Rules address visible emissions prohibition, incinerator standard, nuisance, and compliance with ambient air emission standards and other standards.	The substantive requirements are applicable to alternatives that generate and manage on-site any materials that have the potential to emit air pollutants, such as soil piles.	San Francisco Bay Area Air Quality Management District Regulation 8, Rule 40, Soil Pile Emissions

Notes:

ARAR applicable or relevant and appropriate requirement
CFR Code of Federal Regulations
USC United States Code

3.3.1.1 Chemical-Specific ARARs

Chemical-specific ARARs are health- or risk-based numerical values or methodologies that, when applied to site-specific conditions, result in the establishment of numerical cleanup values. These values establish the acceptable amount or concentration of a chemical that may be found in, or discharged to, the ambient environment.

The scope of the removal action does not include groundwater or adjacent surface water restoration; rather the action is only for containment. Therefore, it is beyond the scope of this removal action to identify chemical-specific ARARs. During the RI/FS, chemical-specific ARARs will be identified. ARARs will be identified for on-site activities, but not for off-site activities, such as discharge to the POTW.

3.3.1.2 Location-Specific ARARs

Location-specific ARARs are restrictions on the concentrations of hazardous substances or on the conduct of activities solely because they are in specific locations. Special locations include flood plains, wetlands, historic places, and sensitive ecosystems or habitats. Site IR-1/21 may include both wetlands and sensitive habitats. Pickleweed has been observed at the margins of Site IR-1/21. Pickleweed provides habitat for the salt marsh harvest mouse, which is a federal threatened and endangered species. Therefore, the Endangered Species Act, Executive Order 11990 Section 404 of the Clean Water Act (CWA) (Protection of Wetlands), and the California Fish and Game Code are potential location-specific ARARs for Site IR-1/21 removal actions. However, potential wetland areas are shown in Figure 7. In addition, because Site IR-1/21 is adjacent to San Francisco Bay, coastal zone requirements may be location-specific ARARs for removal actions. Table 8 summarizes potential location-specific ARARs for this removal action based on current site data.

3.3.1.3 Action-Specific ARARs

Action-specific ARARs are technology- or activity-based requirements or limitations on actions taken with respect to hazardous substances. These requirements are triggered by the particular remedial activities selected. Action-specific ARARs do not in themselves determine the remedial alternative; rather, they indicate how a selected alternative must be implemented. Therefore, because action-specific ARARs depend on the action selected, they will be evaluated in greater detail after alternatives have been developed (see Section 5.0). Table 8 lists potential action-specific ARARs for the alternatives discussed in Section 5.0.

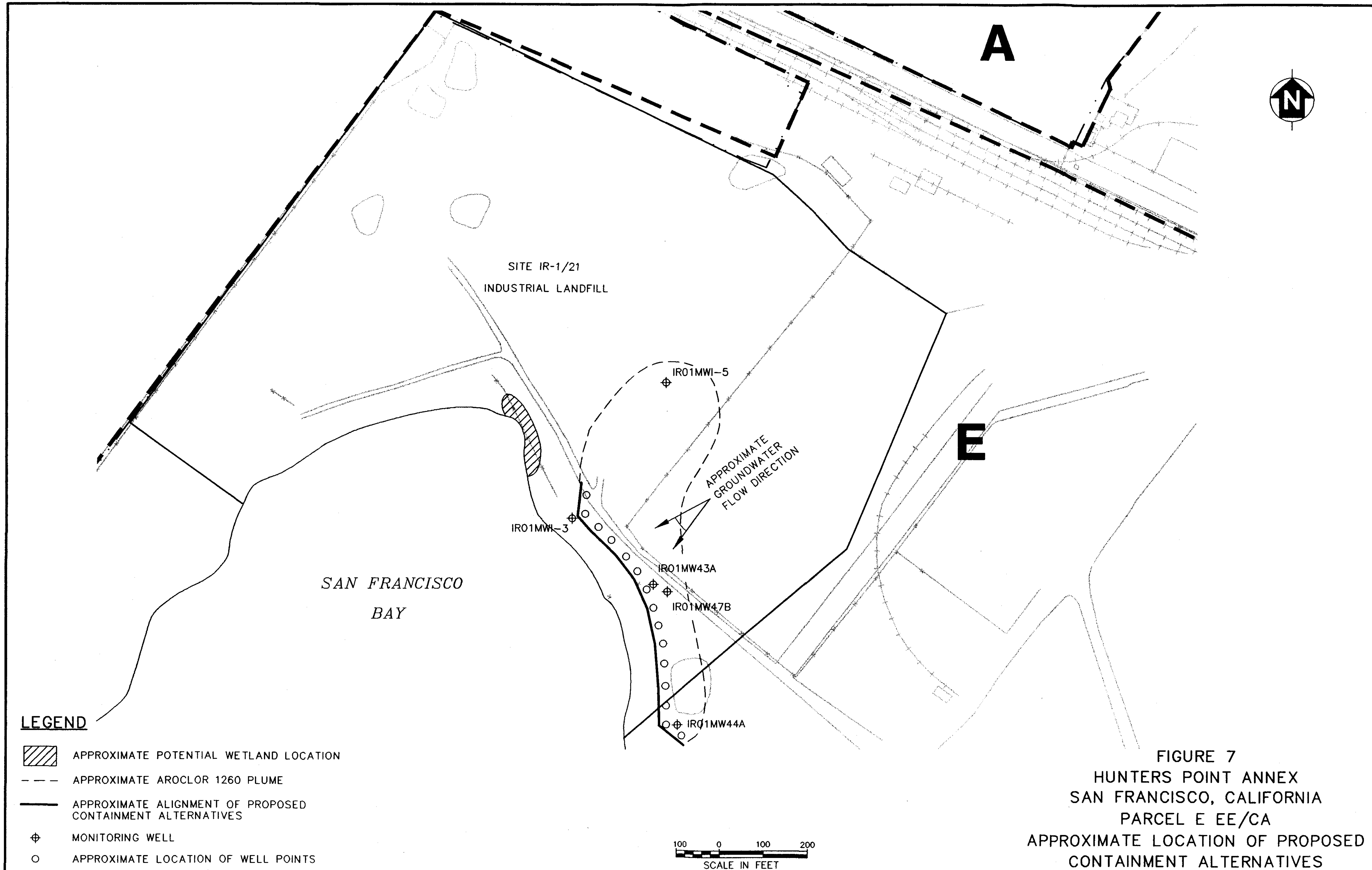

FIGURE 7
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
PARCEL E EE/CA
APPROXIMATE LOCATION OF PROPOSED
CONTAINMENT ALTERNATIVES

The substantive requirements of the Resource Conservation and Recovery Act (RCRA) are potential ARARs for removal actions. The state of California has been authorized by EPA to implement the hazardous waste program; therefore, RCRA citations reference the CCR. Construction activities may generate waste materials, such as excavated soils. The manner in which these materials are handled will depend on the nature of the materials. Materials will first be characterized, for example, as hazardous or solid wastes. Excavated soils or extracted groundwater may exceed toxicity characteristic hazardous waste levels. Therefore, in accordance with EPA's contained-in policy, the soil and groundwater will be managed as hazardous waste until it no longer contains the hazardous waste (that is, no longer exhibits the toxicity characteristic). Any on-site management of a hazardous waste or material that contains a hazardous waste will meet the appropriate substantive requirements of CCR Title 22, Division 4.5.

San Francisco Bay Area Air Quality Management District (BAAQMD) Rules, Regulation 8, Rule 40 is a potential ARAR for removal action alternatives that generate soil piles that may aerate and release emissions.

Removal actions often include a discharge, such as treated or untreated groundwater or air emissions. The requirements that are relevant and appropriate are determined by the substance being discharged and the destination of the discharge. The potential discharges and associated requirements are listed in Table 8 and discussed in Section 5.0.

4.0 REMOVAL ACTION ALTERNATIVES

Removal action alternatives can be developed only after technology options are evaluated and screened. The most applicable options are then assembled into removal action alternatives. Section 4.1 provides the technology screening. Section 4.2 identifies the removal action alternatives.

4.1 TECHNOLOGY SCREENING

The primary technologies available for reducing groundwater contaminant migration are impermeable barriers, groundwater extraction followed by treatment, and permeable treatment walls. Process options under each of these technologies are discussed in the following sections. For the technology screening, it is assumed that the removal action will be operated for 3 years. It is assumed that 3 years of operation will be required until a regional approach to groundwater contamination can be adopted, which will occur after the Parcel E RI/FS is complete.

4.1.1 Impermeable Barriers

Impermeable vertical barrier technologies include slurry walls (using conventional excavation or deep soil mixing), grout injection, and sheet piling walls. Vertical barriers using slurry mixtures are composed of low-permeability material such as sodium bentonite or bentonite soil mixtures (with hydraulic conductivity ranging from 1E-08 centimeters per second [cm/sec] to 1E-05 cm/sec). Each of the three barrier types is usually placed perpendicular to groundwater flow and penetrate to the depth of a naturally occurring aquitard to contain one or more hydrostratigraphic zones beneath the site.

4.1.1.1 Slurry Walls

Typical slurry walls are composed of soil-bentonite or cement-bentonite mixtures. Based on vertical positioning, walls are either "keyed" into a low-permeability formation below the aquifer, or placed to only intercept the upper portion of the aquifer. This latter type is commonly referred to as a "hanging" slurry wall.

Slurry wall construction requires excavating (sometimes blindly) a trench through a bentonite-water slurry or a biopolymer slurry, depending on trench wall stability and the intended use of the trench following excavation. After excavating through a bentonite-water slurry, the trench is solidified (forming an impermeable wall) by backfilling with a mixture of bentonite and soil (or bentonite and cement). In some cases, cement can be mixed with the bentonite slurry during excavation, which will subsequently solidify forming the impermeable wall in situ. In addition, if the depth of the trench is not excessive and the trench will remain open during excavation, it may be excavated without slurry and subsequently backfilled with a soil-bentonite mixture, cement-bentonite mixture, or cement. These backfilled trenches are typically referred to as a soil-bentonite (SB) trench or wall or a cement-bentonite (CB) trench or wall. SB walls have poor performance in the presence of high concentrations of electrolytes (salts), such as sodium, calcium, and sulfates in the groundwater.

Near the shoreline of Site IR-1/21, the average depth to Bay Muds is approximately 15 feet bgs. The Bay Muds would be an effective aquitard to "key" a slurry wall into and would effectively complement a slurry wall. Slurry walls also have relatively low costs compared to grout curtains and sheet piling. Therefore, slurry walls will be retained for further consideration.

In specific cases where containment and extraction are required in the same trench (for example due to spatial constraints), a biopolymer slurry can be used during excavation. Interconnected containment panels can then be lowered through the slurry to the required depth, and permeable gravel backfill added upgradient of the containment panels, displacing some slurry. The remaining slurry within the backfill can be biodegraded with specific "breaking" agents, which are circulated through the permeable trench gravel during development to remove all remaining biopolymer slurry and to remove fines within the gravel backfill. At Site IR-1/21, containment and extraction are not required in the same trench, as space constraints are not present. However, this technology may be cost-effective because containment and extraction are achieved by only one trench; therefore, it will be considered further.

4.1.1.2 Grout Injection

Grouting is the process of injecting a liquid, slurry, or emulsion under pressure into the soil. The fluid injected will distribute from the point of injection to occupy available pore spaces. Over time, the injected fluid will solidify, thus resulting in a decrease in the original soil permeability and an increase in the soil-bearing capacity.

There are two types of grouts: particulate and chemical. Particulate grout consists of water plus particulate material that will solidify within the soil matrix. Chemical grout usually consists of two or more liquids that will gel when they come in contact with each other.

Grout injection is limited to granular types of soils that have a pore size large enough to accept grout fluids under pressure yet small enough to prevent significant (post-grouting) permeability. The existence of coarse materials with potentially large pore size at the shoreline indicates that grout curtains may not be effective. In addition, construction of an impermeable "curtain" is costly due to the required number of closely spaced drill holes. Therefore, grout curtains will not be considered further.

4.1.1.3 Sheet Piling

Sheet piling cutoff walls are constructed by driving lengths of interlocking steel sheets into the ground using a pneumatic or steam-driven pile driver to form a thin impermeable barrier to groundwater or contaminant flow. The effectiveness of sheet pile walls in containing contaminants depends on the seal established between interlocking sheets. Initially, typical sheet piles are not totally impermeable because of small gaps in the connections. Over time, these gaps are closed as groundwater flow carries fine particles into the gaps and clog them. Specialized sheet pile is available that uses groutable interlocking joints; the joints are pressure grouted after the sheet piles are installed.

Installation is relatively simple. The steel sections are assembled (usually in pairs) before being driven into the ground. Lengths of sheet piles range as necessary, typically between 4 and 40 feet, and their widths range between 15 and 24 inches. The sections are then driven into the ground using a pile hammer hanging from a crane guided by an alignment template on the ground. After the piles have been driven to the desired depth, the remaining aboveground portions are cut off. Pile driving requires a relatively uniform, loose soil profile free of boulders and large refuse or debris for ease of construction, and utilities must be removed prior to installation.

No excavation is required for sheet piling; therefore, complications with trenching are avoided. In addition, corrosion protection (coating) is available for sheet piles. Therefore, sheet piling can be more permanent than a slurry wall and can provide containment for a long period of time. Also, although sheet piling is typically more expensive than a slurry wall, sheet pile sections are reusable and more durable. Available soil boring data indicates that the subsurface area along the proposed containment wall alignment is free of boulders and large debris. Sheet piling will be considered further.

4.1.1.4 In Situ Deep Soil Mixing

Subsurface impermeable walls can be constructed by mixing soil in situ with a cement or bentonite slurry. The soils are mixed in situ by multiple-shaft augers equipped with injection ports. As the augers are driven down into the subsurface, slurry is injected into the subsurface through the ports. The augers mix the slurry with soil to form a cement column. Multiple columns are then constructed side by side to form a barrier wall. This technology is typically suited for applications that require containment at depths of 50 to 60 feet. In situ soil mixing is usually not cost-effective at shallow depths such as those found at Site IR-1/21. Therefore, the deep soil mixing technology will not be considered further.

4.1.2 Groundwater Extraction

Groundwater extraction systems are used to remove contaminated groundwater for treatment, as well as for groundwater containment. These systems manipulate the subsurface hydraulic gradient through withdrawal of water. By controlling the movement of groundwater, groundwater extraction systems can control and extract subsurface contamination. Analysis of available information on Site IR-1/21 indicates a containment option using groundwater extraction wells would likely result in a high proportion of bay water being extracted along with the contaminated water emanating from the landfill. This would have the undesirable effect of diluting the contamination and adding significantly to the water volumes for disposal. Additionally, the extraction system would enhance salt water intrusion and possibly call for detailed studies to assess effects on wetlands and bay and estuary issues. For these reasons, containment using groundwater extraction wells will not be considered further. However, groundwater extraction may be considered in combination with subsurface containment walls. There are two common methods used to extract groundwater; extraction wells and interceptor trenches. These two collection/extraction options are considered below.

4.1.2.1 Extraction Wells

There are two general types of extraction well systems: well point systems and deep well systems. Well point systems involve a number of closely spaced, shallow wells connected by a header pipe, which is connected to a centrally located suction-lift pump. Well points are specially made well screens that are typically 1.5 to 3.5 inches in diameter. Well point screens can be made of heavy wire mesh, continuous wire, slotted plastic, or perforated plates. Well points can be installed using a variety of methods including jetting and driving. The maximum drawdown obtainable by suction-lift pumps is about 25 feet. Therefore, well point systems are best suited for shallow aquifers where extraction is not needed below more than 15 to 20 feet bgs. Well point systems are versatile and are effective in most hydraulic conditions. Well points are relatively inexpensive even when closely spaced. A normal well-point spacing is 5 to 10 feet and a normal range of capacity is 0.1 gallons per minute (gpm) to 25 gpm per point. At Site IR-1/21, well points would be suitable since extraction is not needed below more than 15 to 20 feet bgs. Therefore, well points will be retained for further consideration.

Deep well systems are used for greater depths and are usually pumped individually. Deep well systems usually require installing several wells at a site which are pumped at specified rates to collect groundwater. Well design and installation techniques vary. Extraction wells are typically installed with hollow-stem augers and are constructed with 4- to 6-inch polyvinyl chloride (PVC) casing and screen. The well screen is surrounded by a filter pack, which is sealed above with bentonite. Submersible pumps are typically used with deep well systems. Deep well systems are better suited for homogeneous aquifers with high hydraulic conductivities and where large volumes of water may be pumped. A normal well spacing is greater than 50 feet and a normal range of capacity is 25 to 3,000 gpm per well. The key hydrologic parameters that control the size and shape of the capture zone formed during groundwater extraction are pumping rate, aquifer thickness, hydraulic conductivity, and hydraulic gradient. Because these aquifer parameters can vary rapidly across a site, capture zones may be very different for similarly constructed wells pumping at similar rates. The effectiveness of a remedial system based on groundwater extraction using extraction wells depends on the number and placement of the extraction wells. A heterogeneous aquifer zone can make prediction of capture zone size and shape unreliable. Simple analytical equations as well as sophisticated numerical modeling may not yield results that reflect actual site conditions. Using well points minimizes the influence of heterogeneous aquifer conditions. Well points can be manifolded at ground surface and flow rates and capture zones can be more easily manipulated due to the close spacing. This manipulation can reduce the amount of water requiring treatment. Therefore, because (1) pumping is only needed 20 feet bgs, (2) well points are inexpensive and easy to install, and (3) well points are more versatile, deep extraction wells will not be considered further.

4.1.2.2 Interceptor Trenches

An interceptor trench is constructed by excavating a trench and laying a perforated pipe along the trench bottom. The pipe is sloped toward a sump and the trench is backfilled with a porous material (usually gravel) to allow gravity flow collection of the groundwater. Interceptor trenches can also be equipped with aboveground suction pumps to remove groundwater. These drains generally function similar to a continuous line of extraction wells. They create a continuous zone of depression and cause groundwater to flow toward the subsurface drain. Subsurface drains can perform many of the same functions as extraction wells. However, drains may be more cost-effective than extraction well systems at sites with low or variable hydraulic conductivity and where pumping systems cannot provide a continuous hydraulic barrier.

Interceptor trenches are effective for collection of groundwater, although clogging can be a problem from siltation. Filters can be installed to minimize clogging of pipe intake holes by fine particles. Also, high concentrations of iron and manganese in the groundwater can cause clogging from the buildup of insoluble compounds. Construction of interceptor trenches can be difficult because it requires excavation in saturated zones. Additional difficulties arise due to the depth of excavation and the physical impediments at and near the surface. Complex lithology and hydrogeology of an aquifer zone can further complicate the construction of interceptor trenches. However, a new trenching technology (biopolymer slurry drainage trench technique) is available that could mitigate many complexities. Therefore, interceptor trenches will be retained for further evaluation.

4.1.3 Groundwater Treatment

Extracted groundwater must be treated or disposed of. Groundwater will be extracted temporarily (3 years estimated) during the removal action until a regional approach to groundwater contamination is adopted. The expected flow rate will be low (30 gpm), and levels of contaminants are fairly low. HPS has a sanitary sewer system that will accept long-term discharges of groundwater. According to the basin plan (RWQCB 1995), sanitary sewer discharge is preferred over a storm sewer discharge. Reuse is the highest discharge option but no viable reuse options for treated groundwater have been identified at HPS. Therefore, extracted groundwater will be discharged to the sanitary sewer system and specific technologies to treat extracted groundwater will not be evaluated in detail in this EE/CA. During the Parcel E RI/FS, detailed groundwater and disposal options can be evaluated and implemented to address the regional VOCs, SVOCs, PCBs, and metals that may require treatment before disposal.

Sanitary sewer influent criteria have been reviewed to determine whether contaminated groundwater from the Site IR-1/21 shoreline would be accepted without pretreatment. Table 9 provides a comparison of sanitary sewer influent limits to maximum detections from wells in the removal action area (wells IR01MW1-3, IR01MW43A, and IR01MW44A). The table shows that contaminant concentrations detected in groundwater are considerably lower than sanitary sewer influent criteria.

The POTW has been contacted and verified it would accept groundwater that meets the influent limits in Table 9 (PRC 1996b).

4.1.4 Permeable Treatment Walls

Permeable walls are trenches or rows of wells constructed perpendicular to the contaminated groundwater flow to establish an in situ reactive zone in the contaminated aquifer. The groundwater is treated as it flows through the wall. This technology relies primarily on natural groundwater flow patterns to bring the groundwater into contact with the reactive zone of the permeable wall. The permeable wall is placed at the leading edge of a plume to reduce the potential for further contaminant migration.

TABLE 9

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COMPARISON OF SANITARY SEWER INFLUENT REQUIREMENTS TO GROUNDWATER CONTAMINANT CONCENTRATIONS IN PROPOSED EXTRACTION AREA[1]

Pollutant	Discharge Limit (μg/L)	Maximum Detection (μg/L)[2]
pH (pH units)	6.0 to 9.5	7.5
Dissolved sulfides	500	NA
Hydrocarbon oil and grease	100,000	NA
Total recoverable oil and grease	300,000	NA
Total suspended solids	—	NA
Chemical oxygen demand	—	NA
Arsenic (total)	4,000	7.2
Cadmium (total)	5,000	ND
Chromium (total)	5,000	22.9
Copper (total)	4,000	21.9
Lead (total)	1,500	ND
Mercury (total)	50	ND
Nickel (total)	2,000	74.7
Silver (total)	600	ND
Zinc (total)	7,000	235
Phenols	23,000	67
Cyanide (total)	1,000	NA
Flashpoint (degrees Centigrade [°C])	60°C	NA
Benzene	500	14
Carbon tetrachloride	500	ND
Chlordane	30	ND
Chlorobenzene	100,000	13
Chloroform	6,000	ND
o-Cresol	200,000	NA
m-Cresol	200,000	NA
p-Cresol	200,000	NA
Cresol	200,000	NA
2,4-D	10,000	NA
1,4-Dichlorobenzene	7,500	16
1,2-Dichloroethane	500	ND
1,1-Dichloroethylene	700	ND
2,4-Dinitrotoluene	130	ND
Endrin	20	ND

TABLE 9 (Continued)

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COMPARISON OF SANITARY SEWER INFLUENT REQUIREMENTS TO GROUNDWATER CONTAMINANT CONCENTRATIONS IN PROPOSED EXTRACTION AREA[1]

Pollutant	Discharge Limit (μg/L)	Maximum Detection (μg/L)[2]
Heptachlor (and its epoxide)	8	ND
Hexachlorobenzene	130	ND
Hexachlorobutadiene	500	ND
Hexachloroethane	3,000	ND
Lindane	400	ND
Methoxychlor	10,000	ND
Methyl ethyl ketone	200,000	ND
Nitrobenzene	2,000	ND
Pentachlorophenol	100,000	ND
Pyridine	5,000	ND
Selenium	1,000	ND
Tetrachloroethylene	700	1.5
Toxaphene	500	ND
Trichloroethylene	500	ND
2,4,5-Trichlorophenol	400,000	ND
2,4,6-Trichlorophenol	2,000	ND
2,4,5-TP (Silvex)	1,000	ND
Vinyl chloride	200	ND
Antimony or antimony compounds	15,000	27.1
Arsenic or arsenic compounds	5,000	7.2
Asbestos	NA	NA
Barium or barium compounds (excluding barite)	100,000	789
Beryllium or beryllium compounds	750	0.32
Cadmium or cadmium compounds	1,000	ND
Chromium (VI) compounds	5,000	ND
Chromium or chromium (III) compounds	5,000	22.9
Cobalt or cobalt compounds	80,000	9.7
Copper or copper compounds	25,000	21.9
Fluoride salts	180,000	1
Lead or lead compounds	5,000	ND
Mercury or mercury compounds	200	ND
Molybdenum or molybdenum compounds	350,000	18.2
Nickel or nickel compounds	20,000	87

TABLE 9 (Continued)

**HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COMPARISON OF SANITARY SEWER INFLUENT REQUIREMENTS TO
GROUNDWATER CONTAMINANT CONCENTRATIONS
IN PROPOSED EXTRACTION AREA[1]**

Pollutant	Discharge Limit (μg/L)	Maximum Detection (μg/L)[2]
Selenium or selenium compounds	1,000	3
Silver or silver compounds	5,000	ND
Thallium or thallium compounds	7,000	ND
Vanadium or vanadium compounds	24,000	24.7
Zinc or zinc compounds	250,000	235
Aldrin	140	ND
Chlordane	250	ND
DDT, DDE, DDD	100	ND
2,4-Dichlorophenoxyacetic acid	10,000	ND
Dieldrin	800	ND
Dioxin (2,3,7,8-TCDD)	1	NA
Endrin	20	ND
Heptachlor	470	ND
Kepone	2,100	ND
Lead compounds, organic	---	ND
Lindane	400	ND
Methoxychlor	10,000	ND
Mirex	2,100	ND
Pentachlorophenol	1,700	ND
Polychlorinated biphenyls (PCBs)	5,000	54
Toxaphene	500	ND
Trichloroethylene	204,000	ND
2,4,5-Trichlorophenoxypropionic acid	1,000	ND

Notes:

1 Groundwater quality in extraction area is the maximum concentration from wells IR01MWI-3, IR01MW43A, and IR01MW44A.
2 Metals concentration are based on filtered samples.
ND Not detected
NA Not available
μg/L micrograms per liter

Permeable walls can be categorized based on the contaminant removal process that is optimized in the reactive zone. Three primary processes are: physical (such as adsorption or volatilization), chemical (such as reductive dehalogenation), and biological (such as aerobic degradation). Each of these types of reaction cells is discussed below.

4.1.4.1 Physical Reaction Walls

In situ reaction cells that rely on physical adsorption have short lives resulting from saturation of cell materials. Based on groundwater turbidity results, cell saturation could be reached before the period of performance of the removal action. Cell material replacement requires retrenching, and the extracted bed material is difficult to regenerate because it mixes with soil during excavation. This technology would be difficult to implement because of cell replacement. Any technology that relies on repeated trenching becomes prohibitively expensive. Therefore, physical adsorption will not be considered further. Another physical process that can be used to remove contaminants from groundwater is volatilization. However, PCBs are not volatile. Therefore, these technologies will not be considered further.

4.1.4.2 Chemical Reaction Cells

In situ reaction cells that rely on chemical reactions can be effective for treating chlorinated compounds. This technology will not reduce petroleum-related constituents. Metal-induced dehalogenation of organic molecules has been studied for a number of years. Dehalogenation is the elimination of a halogen such as a chlorine atom from a chlorinated alkane or alkene. The process is controlled by the oxidation-reduction (redox) potential of a zero-valence metal and the relatively oxidized condition of halogenated organic compounds. Although a variety of metals could be used in this process, iron is the metal of choice in environmental applications due to its low cost and nontoxic characteristics. Therefore, this technology will be referred to as the iron curtain.

In the iron curtain application, the metallic iron particles create a highly reducing environment in the immediate vicinity of the particles. As contaminated groundwater flows around these particles, the halogen-hydrocarbon bonds become unstable, and nontoxic halogen ions are released to the groundwater. The resulting hydrolyzed hydrocarbon is nontoxic, or of lower toxicity, and its persistence in the groundwater is limited by rapid natural degradation. However, the iron curtain technology has not been demonstrated to be effective to remediate PCBs. Therefore, this technology will not be considered further.

4.1.4.3 Biological Reaction Cells

Biological treatment uses microorganisms to transform harmful chemicals into less toxic compounds. Organic constituents in the water come into contact with the microorganisms, are used as food, and are oxidized to carbon dioxide and water. As microorganisms use the organic compounds, they reproduce and grow. Biological reaction cells use the permeable cell to enhance the introduction of dissolved substances (for example, nutrients, a soluble carbon source, and oxygen) into an aquifer. These substances can be introduced using a trench or well series configuration. The injected substances are dispersed as the groundwater moves out of the permeable wall into the aquifer material, establishing a bioactive zone. The degradation does not occur within the reaction wall; rather, it occurs in the aquifer material downgradient from the cell, in the bioactive zone. Time is required after the cell is installed for the microbial population to adapt to the new conditions and establish an effective population.

Chlorinated hydrocarbons such as PCBs are more efficiently degraded in anaerobic environments (using reductive dehalogenation mechanisms). Therefore, substances that promote anaerobic activity could be injected (such as soluble carbon substrates capable of consumption by aerobic and anaerobic microbes).

This option is innovative and is currently being studied (Devlin and Baker 1994). The effectiveness of this system depends on the biodegradability of PCBs, the characteristics of the aquifer (whether it will promote dispersion), level of contaminants initially present in the groundwater, and the remediation level to be achieved. The implementability of this option is related to the ability to build trenches and the acceptability of injecting the necessary substances into the aquifer. Therefore, detailed treatability studies would first be required to evaluate both the effectiveness and implementability of bioremediating PCBs. Implementing treatability studies does not allow for completing the removal action in a timely manner. In addition, the capital costs are moderately high. Therefore, biological reaction walls will not be considered further.

4.2 IDENTIFICATION OF REMOVAL ACTION ALTERNATIVES

Based on the screening presented in Section 4.1, alternatives have been developed for the removal action at Site IR-1/21 assuming the PCB and PAH contamination is widespread in the southeast portion of the site. These alternatives are:

- Containment with Sheet Piling, Groundwater Extraction with Well Points, Discharge to the Sanitary Sewer
- Containment with Slurry Wall, Groundwater Extraction with Well Points, Discharge to the Sanitary Sewer
- Containment and Extraction with a Biopolymer Slurry Trench, Discharge to the Sanitary Sewer.

5.0 ANALYSIS OF REMOVAL ACTION ALTERNATIVES

Each alternative is described in the following sections and is evaluated based on effectiveness, implementability, and cost. For comparison, the no action alternative is also evaluated.

To evaluate effectiveness, consideration is given to the overall protection of human health and the environment; compliance with ARARs and other guidance; and both the long- and short-term effectiveness of the alternative. Evaluation of the implementability of each alternative included consideration of technical feasibility, commercial availability, administrative feasibility, and public acceptance.

The cost evaluation is based on estimates for capital costs and annual operation and maintenance (O&M) costs. Capital costs include the costs for materials, construction, equipment, mobilization, and decommissioning. O&M costs include equipment rental, labor, analytical costs, transportation, and disposal costs. For this analysis, it has been assumed that all operations will be conducted by contractors at a labor cost of $24/hour for operators and technicians. The cost estimates are comparative estimates with +50/-30 percent accuracy. A present worth has been calculated for each based on a 4 percent interest rate. The present worth analysis provides a single figure representing the amount of money that, if invested in the base year and dispensed as needed, would cover all cost associated with the alternative. The present worth calculation normalizes alternatives that have differing operating lifetimes to facilitate comparisons.

5.1 ALTERNATIVE 1: NO ACTION

5.1.1 Description

Under this alternative, no removal action would be implemented.

5.1.2 Effectiveness

At Site IR-1/21, PCBs, PAHs, and zinc (detected in samples from wells near the bay) were the only chemicals detected above the screening criteria that may pose an immediate threat to human health and the environment. Additional groundwater sampling is needed to confirm that this contamination is widespread and migrating toward San Francisco Bay. If additional groundwater data indicate that the contamination is localized and that hydraulic conductivity is limiting contaminant migration, a removal action may not be necessary. However, if additional data indicate widespread contamination, the no action alternative would not be effective in limiting migration toward the bay. Overall protection of human health and the environment and compliance with ARARs would not be achieved if contamination is widespread.

5.1.3 Implementability

The no action alternative would be technically implementable. However, the no action alternative may not be acceptable to the state (or other support agencies) and the community.

5.1.4 Cost

This alternative would include groundwater monitoring costs and additional field work. However, the costs for groundwater monitoring and field work are similar among all of the alternatives. Therefore, the cost opinions given in this EE/CA are for comparative purposes, no groundwater monitoring costs or field work costs will be presented for any alternative. On that basis, this alternative has no costs.

5.2 ALTERNATIVE 2: SHEET PILING, GROUNDWATER EXTRACTION, SANITARY SEWER DISCHARGE

5.2.1 Description

Alternative 2 includes containment with sheet piling, groundwater extraction with well points, and discharge to the sanitary sewer. Based on borelogs from borings drilled near the shoreline, it is estimated that sheet pile would need to be driven to an average depth of 15 feet bgs to key into Bay Mud. Table 10 shows the depth to Bay Muds for 16 borings along the shoreline. Based on current monitoring well data, approximately 600 feet of sheet pile would be needed. This estimate will be revised following additional field work. Figure 7 shows the estimated location of a containment wall to be implemented under this removal action.

TABLE 10

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
DEPTH TO BAY MUD NEAR SHORELINE

Monitoring Well/ Soil Boring Number	Approximate Distance to San Francisco Bay (feet)	Depth to Fill/Bay Mud (Qaf/Qbm) Interface (bgs) (feet)
IR01B064	50	15
IR01MWI-8	70	greater than 12.5
IR01MWB060	150	9
IR01B273	150	12.5
IR01MWI-7	85	greater than 13
IR01MW53B	130	9.5
IR01MW48A	125	18
IR01MW38A	180	20
IR01B036	125	15
IR01B039	90	20
IR01B275	180	26
IR01MWI-3	55	greater than 17
IR01MW43A	115	22.5
IR01MW47B	130	13
IR01B045	235	6.5
IR01MW44A	130	7.5

Note:

bgs below ground surface

Upgradient from the sheet piling wall, well points would be installed to extract groundwater and maintain an inward gradient from the bay. By maintaining an inward gradient from the bay to the landfill, contaminant migration into the bay will be minimized. A 20-foot spacing should be adequate for well points since saturated permeable sediments frequently have been found along the shoreline. Therefore, it is assumed that 30 4-inch diameter steel well points would be installed to a 15-foot depth bgs under this alternative. It is also assumed that 1 gpm can be sustained from each well point. At ground surface, the well points would be piped into a common header. At least two 15 gpm suction pumps would be located at the common header to extract groundwater. Groundwater would be pumped to the sanitary sewer. At Site IR-1/21, there is a sanitary sewer line near Building 810, approximately 900 feet from a well-point collection header location. Therefore, additional pumps would be required to transfer 30 gpm of water to the sanitary sewer. Sanitary sewer influent criteria have been reviewed to determine whether contaminated groundwater from the southeast corner of Site IR-1/21 would be accepted without pretreatment. Table 9 in Section 4.1.3 provides a comparison of sanitary sewer influent limits to maximum detections from wells in the removal action area (wells IR01MW1-3, IR01MW43A, and IR01MW44A). The table shows that contaminant concentrations detected in groundwater are considerably lower than sanitary sewer influent criteria. The POTW has indicated that the plant could handle the proposed discharge (PRC 1996b). The Navy would have to obtain a discharge permit from the POTW.

5.2.2 Effectiveness

Alternative 2 should provide an effective barrier to contaminant migration into San Francisco Bay. By installing a relatively impermeable sheet piling barrier into Bay Muds and extracting groundwater, an inward gradient toward the landfill should be easily maintained. The sheet piling barrier would prevent large amounts of San Francisco Bay water from being pumped and treated, thereby minimizing costs. In addition, the sheet piling barrier combined with groundwater extraction should reduce contaminant migration into the bay. Therefore, Alternative 2 should provide overall protection of human health and the environment and reduce toxicity, mobility, and volume through treatment.

Several location-specific ARARs may apply to Alternative 2. The location of the containment wall and groundwater collection system is close to a potential wetland (see Figure 7). To comply with these location-specific ARARs, the Navy would consult with the U.S. Army Corps of Engineers (wetlands), the U.S. Fish and Wildlife Service (endangered species), and the California Fish and Game. Mitigation plans could be developed to comply with these ARARs. The California Coastal

Act of 1976 would not be an ARAR for Alternative 2 because no discharges would occur to the coastal zone. BAAQMD Regulation 8, Rule 40 is not an ARAR for this alternative because no soil piles are expected to be generated during sheet pile driving. Any soil cuttings from well installation would be containerized and sampled prior to off-site disposal. The only action-specific ARAR for Alternative 2 is compliance with hazardous waste requirements (CCR, Title 22, Division 4.5). All waste-like materials will be characterized and managed appropriately. The groundwater is not expected to exceed toxicity characteristic levels based on maximum groundwater concentrations and current statutory levels; therefore, waste requirements are not ARARs for managing groundwater. Soils generated during construction activities (well installation) may exceed toxicity characteristic levels. If so, they will be managed as hazardous waste if they are removed from the construction area. Specifically, the material would be placed in containers, labeled, and manifested for off-site disposal. In addition, all land disposal restrictions will be complied with. Soils excavated to check for utilities and immediately backfilled will not be considered waste-like and will not be sampled. Alternative 2 would comply with identified ARARs.

Sheet piling and a groundwater extraction system should provide both long- and short-term effectiveness. Corrosion protection (coated sheet pile) is available to minimize corrosion and maintain performance over the long term. In addition, minimal subsurface disturbance is required to install sheet pile or well points. Therefore, short-term exposure to potentially contaminated soils during construction is minimal.

5.2.3 Implementability

Sheet piling and well points should be both technically and administratively implementable. Sheet piling is a proven technology and services and materials should be readily available. No excavation is required; therefore, complications with trenching are avoided. Pile driving is not possible in extremely rocky soil or where boulders or large subsurface debris may be encountered. However, based on borelogs in the area, these subsurface conditions are not expected. Additional CPT data will provide more detailed information on the lithology at the removal action area. Implementability of this alternative will be reevaluated when CPT results become available. The proposed containment wall placement (shown in Figure 7) relative to the shoreline will likely remain unchanged. The shoreline is a relatively steep embankment in places and the whole stretch of shoreline paralleling the proposed alignment of the containment wall is covered with concrete rubble, reinforcing rod, and other rocky rubble as a rip rap armour. The POTW has been contacted, and they have indicated they would accept the proposed discharge (PRC 1996b). The Navy would obtain a discharge permit from the POTW. It is anticipated that Alternative 2 would be acceptable to the state (or other support agencies) and the community.

5.2.4 Cost

The total cost for Alternative 2 is $965,100. The cost breakdown is as follows.

- Estimated capital cost ($339,300)
- Estimated annual O&M cost ($225,500)
- Estimated duration of removal (3 years)

Material and shipping costs for sheet piling are typically very high. However, sections are reusable and need not be left in place permanently. In addition, light-weight steel is adequate if no significant load resistance is required. The following unforeseen conditions during construction could significantly increase cost:

- Surface soils too soft to support heavy equipment.
- Large boulders, debris or hard rock layers.

5.3 ALTERNATIVE 3: SLURRY WALL, GROUNDWATER EXTRACTION, SANITARY SEWER DISCHARGE

5.3.1 Description

Alternative 3 is similar to Alternative 2 except that a slurry wall would be constructed to function as an impermeable barrier instead of a sheet piling wall. Similar to Alternative 2, well points and sanitary sewer discharge are part of Alternative 3.

A SB slurry wall would be constructed under Alternative 3. The slurry wall will be keyed into the Bay Mud formation 15 feet bgs.

The keyed SB slurry wall combined with groundwater extraction will contain contaminants dissolved in groundwater. The SB slurry wall will require adequate space for mixing the soil and bentonite. Mixing occurs outside the trench, and is then backfilled into the trench, displacing the slurry. A remote mixing area should not be required at Site IR-1/21. The soil used in the mixture should contain between 30 and 40 percent fines. If the native soils do not contain adequate fines, imported backfill must be acquired for mixing, adding significant cost to construction. It is assumed that imported backfill will be needed at Site IR-1/21. The trench spoils will be treated on-site. A soil treatment pad must be constructed to handle the soils. Treated soils would be used as backfill or subbase if the landfill is capped later, depending on the levels of contaminants in the treated soils. Reuse of soils would be evaluated to ensure that unsafe exposure to remaining contaminants did not evolve. The SB slurry walls must be constructed as one continuous section, and are limited to areas where the maximum slope along the trench alignment is about 2 percent or less.

Trench excavation is typically accomplished by any one or combinations of the following equipment: a backhoe; track- or rubber-tired excavator; dragline; clamshell; bucket scraper; rotary drilling equipment; specialized equipment designed to excavate and backfill simultaneously; or deep soil mixing auger rigs designed to mix bentonite or cement in situ. A backhoe is typically used for shallow depths such as at Site IR-1/21.

5.3.2 Effectiveness

Alternative 3 should provide an effective barrier to contaminant migration into San Francisco Bay. By installing a relatively impermeable SB slurry wall into Bay Muds and extracting groundwater, an inward gradient toward the landfill should be easily maintained. The SB slurry wall barrier would prevent large amounts of San Francisco Bay water from being pumped and treated, thereby minimizing costs. In addition, the SB slurry wall barrier combined with groundwater extraction should limit contaminant migration into the bay. Therefore, Alternative 3 should provide overall protection of human health and the environment and reduce toxicity, mobility, and volume through treatment. An SB slurry wall and a groundwater extraction system should provide both long- and short-term effectiveness. Slurry walls have been guaranteed to last 20 to 40 years. However, hydrologic (seasonal or tidal) fluctuation in the water table can cause excessive desiccation, which can significantly increase the porosity of the wall. Tidal influence has been observed in a zone along the margin of the bay ranging in width from 200 to 600 feet.

Several location-specific ARARs may apply to Alternative 3. The location of the containment wall and groundwater collection system is close to a potential wetland (see Figure 7). To comply with these location-specific ARARs, the Navy would consult with the U.S. Army Corps of Engineers (wetlands), the U.S. Fish and Wildlife Service (endangered species), and the California Fish and Game. Mitigation plans could be developed to comply with these ARARs. The California Coastal Act of 1976 would not be an ARAR for Alternative 3 because no discharges would occur to the coastal zone. BAAQMD Regulation 8, Rule 40 is a potential ARAR for this alternative because soil piles are expected to be generated during trenching. Soil pile treatment would comply with this ARAR. The only action-specific ARAR for Alternative 3 is compliance with hazardous waste requirements (CCR, Title 22, Division 4.5). All waste-like materials will be characterized and managed appropriately. The groundwater is not expected to exceed toxicity characteristic levels based on maximum groundwater concentrations and current statutory levels; therefore, hazardous waste requirements are not ARARs for managing groundwater. Soils generated during construction activities may exceed toxicity characteristic levels. If so, they will be managed as hazardous waste if they are removed from the construction area. Specifically, the material would be placed in containers, labeled, and manifested for disposal. In addition, all land disposal restrictions will be complied with. Soils excavated to check for utilities and immediately backfilled will not be considered waste-like and will not be sampled. Alternative 3 would comply with identified ARARs.

During construction, there is potential for exposure to subsurface contamination. However, construction workers can use personal protective equipment (PPE) to minimize these hazards.

5.3.3 Implementability

An SB slurry wall and well points should be both technically and administratively implementable. SB slurry wall construction is a proven technology and services and materials should be readily available. However, improper construction techniques or adverse physical and chemical processes can affect the integrity of the wall. For example, SB slurry walls have performed poorly in the presence of high concentrations of electrolytes, such as sodium, calcium, and heavy metals in the groundwater. Therefore, implementing a slurry wall will require groundwater contaminant compatibility testing and post-construction materials and effectiveness testing. In addition, slurry wall construction requires large amounts of relatively clean water and off-site soil if native soils are not suitable. It is anticipated that Alternative 3 would be acceptable to the state (or other support agency) and the community.

5.3.4 Cost

The total cost for Alternative 3 is $896,100. The cost breakdown is as follows.

- Estimated capital cost ($270,300)
- Estimated annual O&M cost ($225,500)
- Estimated duration of removal (3 years)

The following unforeseen conditions during construction could significantly increase cost:

- Surface soils too soft to support heavy equipment.
- Trench collapse due to a sudden rise in groundwater levels close to the surface.
- Trench wall collapse due to unstable or uncompacted soil profile.
- Excavation of large boulders or hard rock layers.
- Sudden slurry losses due to encounters with gravel lenses, subsurface pipe conduits, or subsurface debris or refuse piles.

5.4 ALTERNATIVE 4: BIOPOLYMER SLURRY TRENCH, GROUNDWATER EXTRACTION, SANITARY SEWER DISCHARGE

5.4.1 Description

Alternative 4 includes construction of a biopolymer slurry trench followed by groundwater extraction from a gravel-backfilled trench and disposal in the sanitary sewer. BP slurry wall construction requires blind excavation of a trench through a BP slurry. After excavation, interconnected containment panels can then be lowered through the slurry to the required depth, and permeable gravel backfill added upgradient of the containment panels, displacing some slurry. The remaining slurry within the backfill can be biodegraded with specific "breaking" agents which are circulated through the permeable trench gravel during development to remove all remaining biopolymer slurry and to remove fines within the gravel backfill. The resulting gravel-backfilled interceptor trench would be approximately 600 feet long and 15 feet deep.

Before backfilling, a perforated pipe would be laid along the trench bottom. The pipe would be sloped toward three sumps. The three sumps would be equipped with riser pipes and pumps to remove groundwater. This trench would generally function similar to a continuous line of extraction wells or well points. It would create a continuous zone of depression and cause groundwater to flow toward the trench. The liner installed on the downgradient side of the trench would restrict inflow from the bay side of the trench. This technique would minimize the flow of clean water, thereby minimizing water treatment requirements. The liner must be keyed into the low-permeability Bay Mud formation located at approximately 15 feet bgs so that groundwater would not travel underneath the downgradient barrier material.

5.4.2 Effectiveness

Alternative 4 should have similar effectiveness compared to Alternatives 2 and 3. See Sections 5.2.2 and 5.3.2 for a discussion of the effectiveness of Alternatives 2 and 3.

5.4.3 Implementability

BP slurry wall construction is a proven technology and services and materials should be readily available. Bay Muds are located approximately 15 feet bgs and it should not be difficult to key the impermeable panels into this aquitard. However, there is potential for excessive slurry loss through the sand and gravel lenses identified in Site IR-1/21 borelogs. Excessive slurry loss can drastically affect implementability, as trench excavation and subsequent panel installation becomes difficult and costly. If slurry loss is apparent, BP slurry wall construction can be augmented with sheet piling to facilitate trench excavation and panel installation. This augmentation increases costs significantly.

5.4.4 Cost

The total cost for Alternative 4 is $1,008,800. The cost breakdown is as follows.

- Estimated capital cost ($383,000)
- Estimated annual O&M cost ($225,500)
- Estimated duration of removal (3 years)

The following unforeseen conditions during construction could significantly increase cost:

- Surface soils too soft to support heavy equipment.
- Trench collapse due to a sudden rise in groundwater levels close to the surface.
- Trench wall collapse due to unstable or uncompacted soil profile.
- Excavation of large boulders or hard rock layers.
- Sudden slurry losses due to encounters with gravel lenses, subsurface pipe conduits, or subsurface debris or refuse piles.

6.0 COMPARATIVE ANALYSIS OF REMOVAL ACTION ALTERNATIVES

In this section, the alternatives analyzed in Section 5.0 are compared to evaluate the relative performance of each alternative in relation to each of the criteria. The criteria used in this comparison are the same as in Section 5.0, namely, effectiveness, implementability, and cost. Table 11 summarizes the comparative analysis and ranks the alternatives.

6.1 EFFECTIVENESS OF ALTERNATIVES

Alternatives 2, 3, and 4 are expected to meet the RAOs similarly, provide protection of human health and the environment, and comply with identified ARARs. Differences are not significant. Alternative 2 would be the most durable of the three. The effectiveness of Alternative 3 could be influenced by tidal effects. Alternative 4 should provide the most effective and efficient means to collect contaminated groundwater. However, the three alternatives should all effectively prevent contaminated groundwater from migrating into San Francisco Bay. Alternatives 2, 3, and 4 are ranked above Alternative 1, which would not meet RAOs if contamination is widespread.

6.2 IMPLEMENTABILITY OF ALTERNATIVES

The no action alternative would be the easiest to implement technically; however, this alternative would probably not be acceptable to the state or community. Therefore, it would be difficult to implement administratively. Differences in implementability among the three containment alternatives arise because of the observed lithology at Site IR-1/21. Borelogs indicate that there are thick intervals of permeable sand and gravel sediments in the artificial fill aquifer. Therefore, there is a high

TABLE 11

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COMPARISON OF REMOVAL ACTION ALTERNATIVES

Evaluation Criteria	Site IR-1/21			
	Alternative 1	Alternative 2	Alternative 3	Alternative 4
Overall Protection of Human Health and the Environment	5	1	2	1
Compliance with ARARs	5	1	2	1
Long-term Effectiveness	5	1	4	2
Reduction of Toxicity, Mobility, Volume	5	1	1	1
Short-term Effectiveness	5	1	2	2
Implementability	1	1	2	3
Cost	1	2	1	2
State and Community Acceptance	5	1	1	1
Sum	32	9	15	13
Overall Rating	4	1	3	2

Ranking Scale:

1 Meets Criteria Best
5 Meets Criteria Least

potential for slurry loss during construction of both Alternatives 3 and 4. Slurry loss during construction can result in frequent trench collapse, making excavation extremely difficult. Conversely, the lithology observed near the shoreline at Site IR-1/21 is favorable for implementing Alternative 2. Sheet pile can easily be installed through sand and gravel. Therefore, based on the subsurface lithology, Alternative 2 should be the easiest containment alternative to implement at Site IR-1/21.

As stated earlier, additional CPT and HP activities are proposed for the southeast portion of Site IR-1/21. HP groundwater samples are proposed to determine whether the PCB, PAH, and zinc contamination is widespread and whether the contaminants are migrating throughout the area and toward the bay. In addition, CPTs will be conducted along the trench alignment to more accurately locate the Qbm/Qaf interface and to confirm that lithology is favorable for driving sheet pile. Therefore, when results from the above-described field work are available, conclusions presented in this EE/CA should be revisited.

6.3 COST OF ALTERNATIVES

Table 12 shows the relative cost of each alternative. Appendix F provides detailed cost estimates. There are no costs associated with Alternative 1. Costs are similar for the three containment alternatives. Alternative 3 has the lowest cost, followed by Alternative 2. Construction of Alternative 4 is expected to have the highest cost. These cost estimates assume that the alternatives are implementable. However, if difficulties arise during implementation, the costs will significantly increase.

7.0 RECOMMENDED REMOVAL ACTION ALTERNATIVE

The EE/CA was performed in accordance with current EPA guidance documents for a non-time critical removal and action under CERCLA (EPA 1988, 1993). The purpose of the EE/CA was to identify and analyze alternative removal actions to address Site IR-1/21 groundwater contamination at HPS. Four alternatives were identified, evaluated, and ranked:

Alternative 1: No Action

Alternative 2: Containment with Sheet Piling, Groundwater Extraction with Well Points, Discharge to the Sanitary Sewer

TABLE 12

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COST ESTIMATE SUMMARY FOR SELECTED ALTERNATIVES

Alternative Number	Site IR-1/21
1	$0
2	$965,100
3	$896,100
4	$1,008,800

Notes:

Total costs include capital costs and present value of 3 year O&M costs. Present worth calculated based on a 4 percent discount rate.

Alternative 3: Containment with Slurry Wall, Groundwater Extraction with Well Points, Discharge to Sanitary Sewer

Alternative 4: Containment and Extraction with a Biopolymer Slurry Trench, Discharge to the Sanitary Sewer

Based on the comparative analysis of the removal action alternatives completed in Section 6.0, the recommended removal action is Alternative 2. Alternative 2 includes containment with sheet piling, groundwater extraction with well points, and discharge to the sanitary sewer. Under this alternative, well points will be installed to extract contaminated groundwater and maintain an inward gradient from the bay. By maintaining an inward gradient from the bay to the landfill, contaminant migration into the bay will be minimized. Extracted groundwater will be discharged to the sanitary sewer and treated by the POTW. This alternative is recommended because it is readily implementable and is cost effective. Sheet piling is a proven technology, and is a reliable and durable means to contain contaminated groundwater. The lithology observed at Site IR-1/21 is favorable for driving sheet pile. Near the southeastern shoreline of Site IR-1/21, Bay Muds are on average 15 feet bgs. Adequate containment should be provided by keying sheet pile into this aquitard. Well points were selected as the groundwater extraction method because they are well-suited for shallow applications such as at Site IR-1/21. Well points provide a versatile means to control groundwater gradients and capture contaminated groundwater. By providing more certain control of hydraulics with well points, the volume of groundwater requiring treatment can be minimized. Well points can be installed by driving or jetting pressure and do not require subsurface drilling to install.

In addition to implementing Alternative 2 under this removal action, the Navy will also plug several storm sewer outfalls north of Site IR-1/21. Figure 8 shows that north of the landfill there may be up to nine storm sewer outfalls that were apparently buried during past filling operations at HPS. Water table surface maps of the area show that discharge from some of these outfalls influences groundwater flow under and through the landfill. Discharges from these outfalls have been likely recharging groundwater, creating a groundwater mound, increasing the gradient from the landfill toward the bay, and potentially increasing leachate generation and migration. Therefore, the Navy will either plug or reroute these outfalls under this removal action.

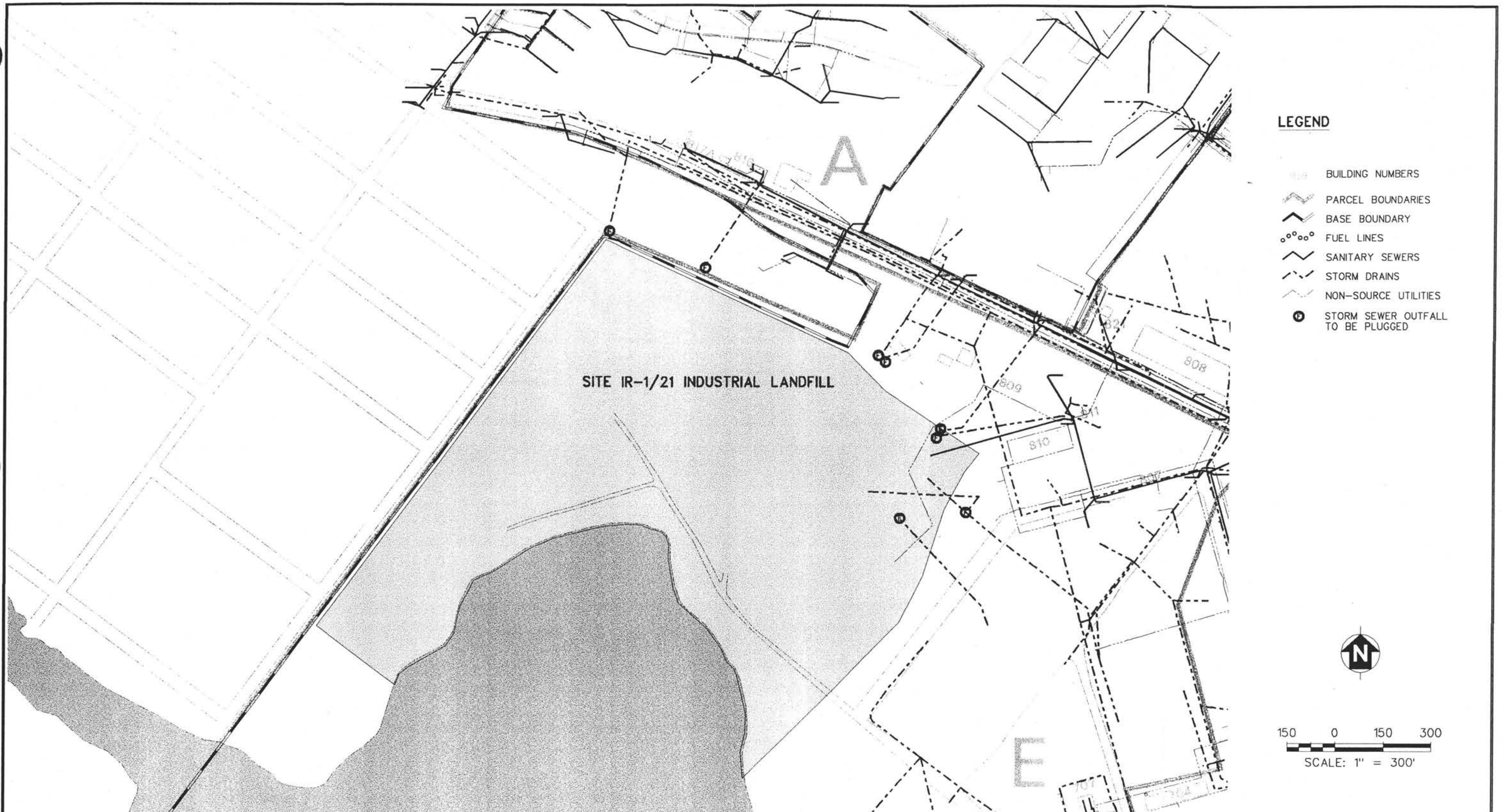

FIGURE 8
HUNTERS POINT ANNEX
SAN FRANCISCO, CALIFORNIA
SITE IR-1/21 EE/CA
UNDERGROUND UTILITIES

05/02/96 ...data0/hunters/amis/byptp7.map DKV

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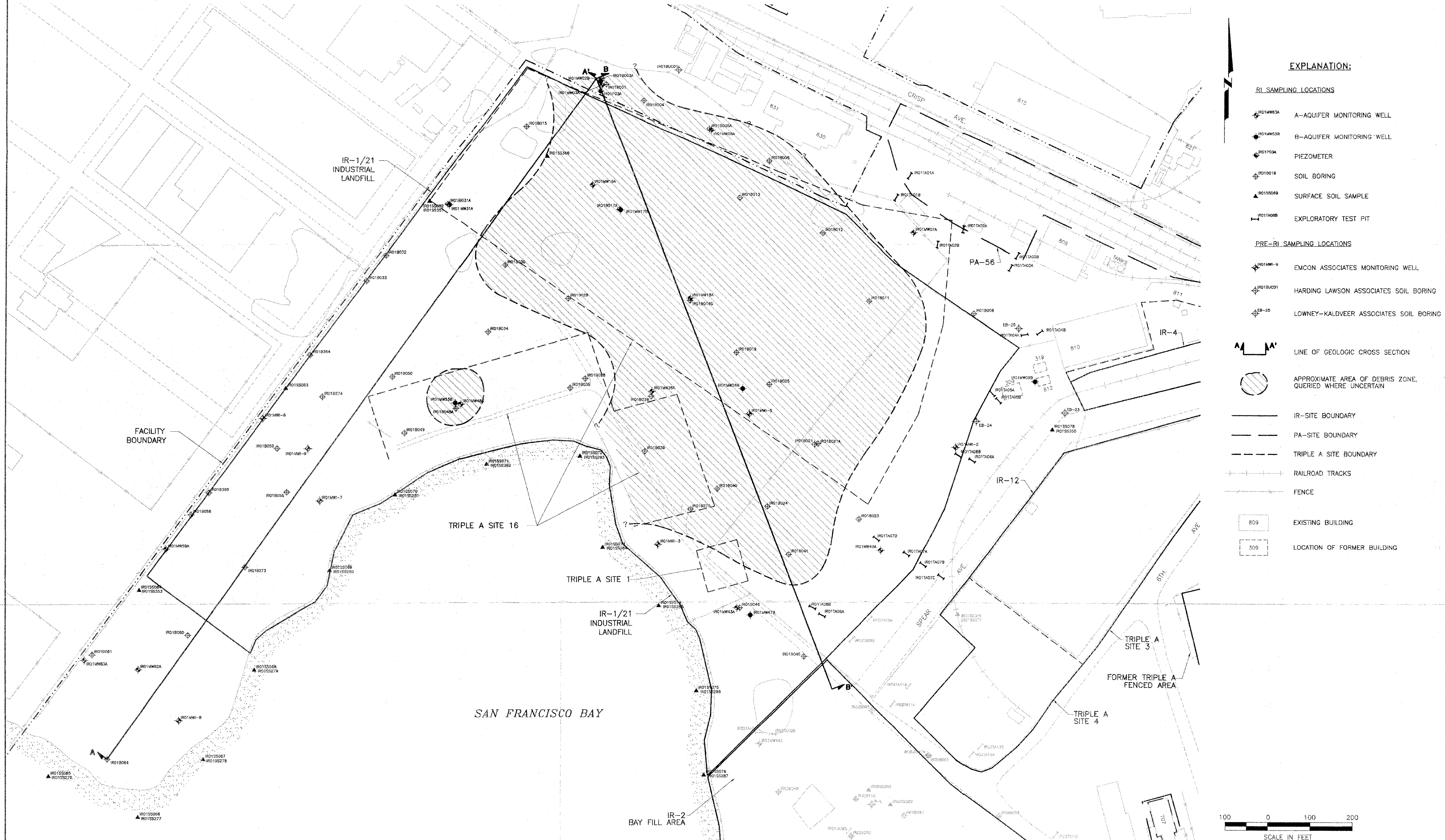
APPENDIX A

SITE IR-1/21 GEOLOGIC CROSS-SECTIONS



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					CHECKED:	APPROVED:
NO.	DATE	REVISIONS	BY	CHK	DATE:	DATE:

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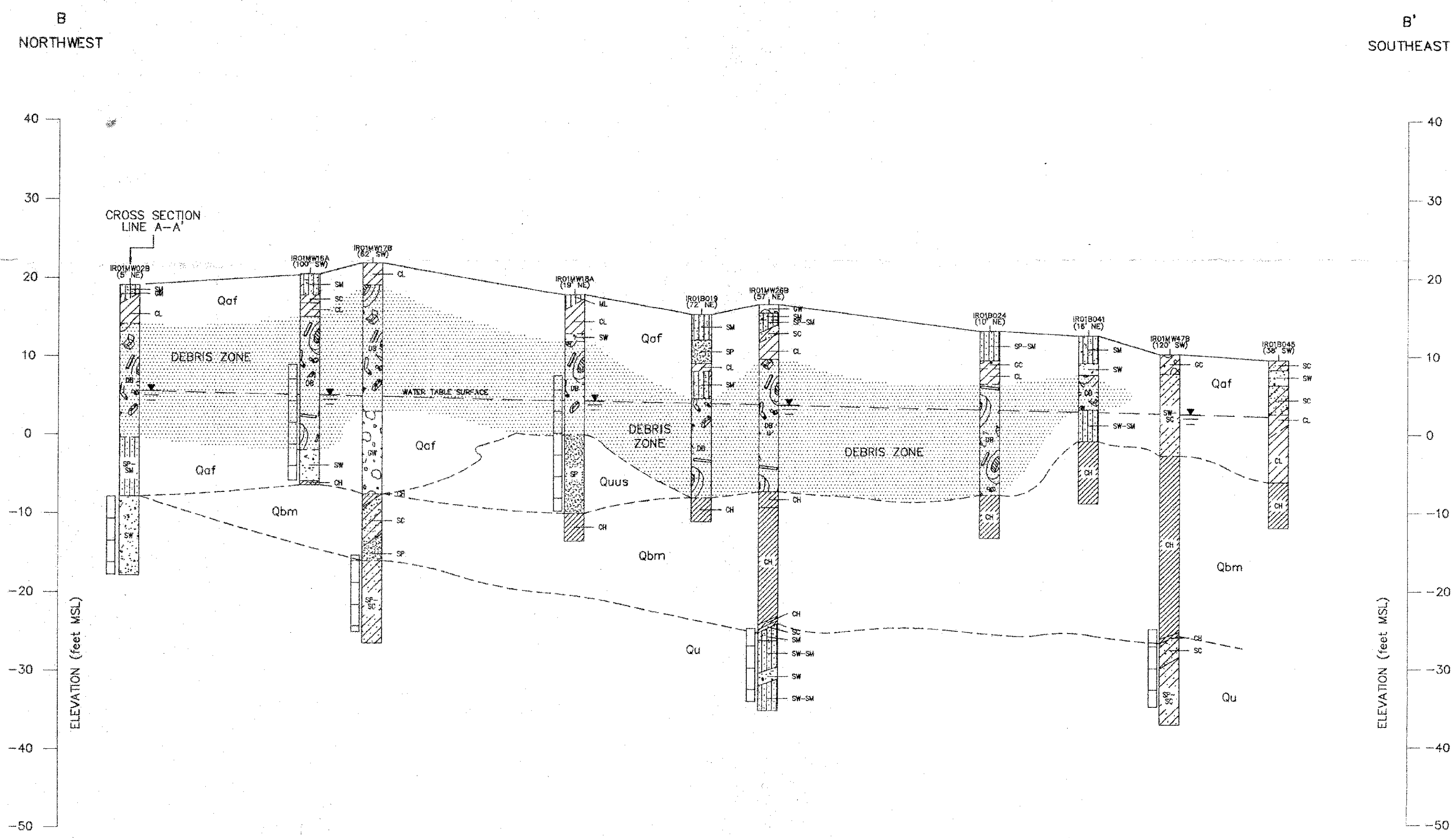
San Francisco, California

SITE MAP
INDUSTRIAL LANDFILL
SITE IR-1/21

PLATE 2
SHEET: OF
REVISION NUMBER:
DATE: 5/93



EXPLANATION:

CROSS SECTION LINE A–A' — INTERSECTION WITH OTHER CROSS SECTION; INTERPRETATIONS AT INTERSECTION POINTS ARE BASED ON BORING LOGS SHOWN ON THE CROSS SECTIONS AND THEREFORE MAY NOT MATCH INTERSECTING CROSS SECTION.

IR01MW02B (5' NE) — BORING OR WELL NUMBER (DISTANCE [in feet] AND DIRECTION FROM THE CROSS–SECTION LINE)

ACTUAL LOCATION OF BORING; THE DIAMETER OF THE LOG ON THE CROSS SECTION IS NOT TO SCALE.

SCREEN INTERVAL

WATER LEVEL IN MONITORING WELL MEASURED ON 7/13/92

APPROXIMATE WATER TABLE SURFACE BASED ON INTERPRETATION OF WATER LEVELS IN MONITORING WELLS MEASURED ON 7/13/92; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

INTERPRETED CONTACT OF GEOLOGIC UNITS; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

Qaf — QUATERNARY ARTIFICIAL FILL
Quus — QUATERNARY UNDIFFERENTIATED UPPER SAND DEPOSITS
Qbm — QUATERNARY BAY MUD DEPOSITS
Qu — QUATERNARY UNDIFFERENTIATED SEDIMENTARY DEPOSITS

DEBRIS ZONE

NOTES:

1) THE ASTM SOIL CLASSIFICATIONS ARE SHOWN ON PLATE 12; THE LOCATION OF THE CROSS SECTION IS SHOWN ON PLATE 2.
2) THE CROSS SECTION IS ONE INTERPRETATION OF THE LITHOLOGIC DATA AND IS BASED ON THE DETAILED REVIEW OF THE BORING LOGS; OTHER INTERPRETATIONS MAY BE POSSIBLE. CONTACTS ARE INFERRED AND QUERIED WHERE UNCERTAIN.

100 0 100 200
SCALE IN FEET
VERTICAL EXAGGERATION = 10x

DRAFT

NO.	DATE	REVISIONS	BY	CHK
	12/14		GK	

DRAWN: GK
ENGINEER:
CHECKED:
DATE:
PROJECT NO: 11400 012302
SCALE: AS SHOWN
APPROVED:
DATE:

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GEOLOGIC CROSS SECTION B–B'

PLATE 7
SHEET: OF
REVISION NUMBER: 0
DATE: 5/11/93

APPENDIX B

WATER-LEVEL ELEVATION CONTOUR MAPS

EXPLANATION:

RI/PA WELLS

IR02MW179A	A–AQUIFER MONITORING WELL
IR01MW26B	B–AQUIFER MONITORING WELL
IR06MW48F	BEDROCK MONITORING WELL
IR09P041	PIEZOMETER

PRE–RI/PA WELLS

IR02MWB-5	A–AQUIFER MONITORING WELL
IR07MWS-1	BEDROCK MONITORING WELL
2.49	GROUNDWATER ELEVATION (FEET MSL)
(5.23)	GROUNDWATER ELEVATION NOT USED IN CONTOURING (FEET MSL)
NM	WATER LEVEL NOT MEASURED DUE TO PONDED SURFACE WATER OVER THE WELL COVER
NC	WATER LEVEL NOT CALCULATED DUE TO THE PRESENCE OF FREE PRODUCT IN WELL
—— 2.0 ——	WATER–LEVEL ELEVATION CONTOUR (FEET MSL) (CONTOUR INTERVAL = 0.5 foot)

NOTES:

1) ALL WATER LEVELS WERE MEASURED FEBRUARY 7, 1992.

2) WATER–LEVEL ELEVATION CONTOUR MAPS ARE BASED ON ONE INTERPRETATION OF THE DATA. OTHER INTERPRETATIONS ARE POSSIBLE.

3) BECAUSE FACILTY–WIDE GROUNDWATER LEVELS WERE TAKEN OVER A 4– TO 6–HOUR PERIOD, GROUNDWATER CONTOURS MAY BE AFFECTED IN AREAS WITH TIDAL INFLUENCE.

400 0 400 800

SCALE IN FEET

DRAFT

NO.	DATE	REVISIONS	BY	CHK
A	04/22	DRAFT	MLK	JSH
B	07/14	PRELIMINARY DRAFT FINAL	MLK	JSH
C	07/24	DRAFT FINAL	MLK	JSH

DRAWN:	PROJECT NO: 11400 012302
ENGINEER:	SCALE: 1"=400'
CHECKED:	APPROVED:
DATE:	DATE:

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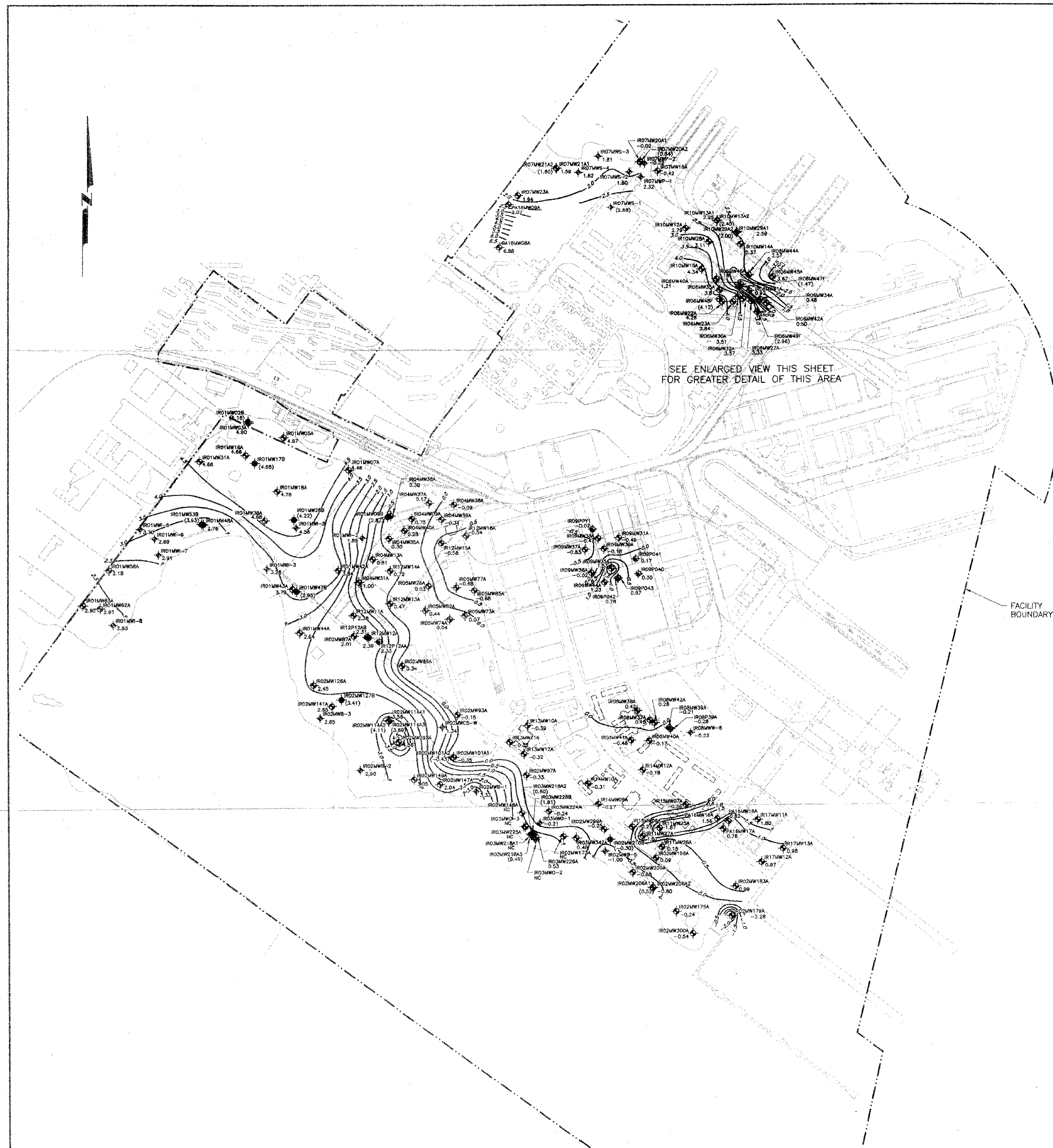
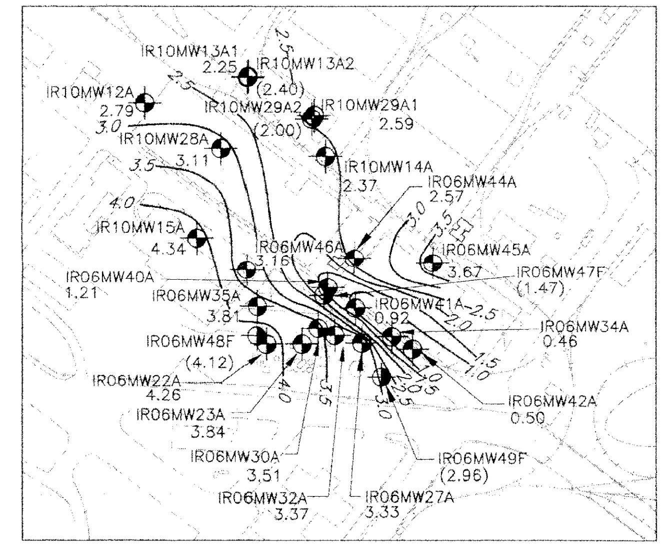
WATER–LEVEL ELEVATION CONTOUR MAP, A–AQUIFER FEBRUARY 1992

PLATE 13
SHEET: OF
REVISION NUMBER: C
DATE: 07/24/92

HPAN0294 400.0
19930607.1415





SCALE: 1" = 200'

EXPLANATION:

RI/PA WELLS

- A-AQUIFER MONITORING WELL
- B-AQUIFER MONITORING WELL
- BEDROCK MONITORING WELL
- PIEZOMETER

PRE-RI/PA WELLS

- A-AQUIFER MONITORING WELL
- BEDROCK MONITORING WELL

1.56 GROUNDWATER ELEVATION (FEET MSL)

(3.16) GROUNDWATER ELEVATION NOT USED IN CONTOURING (FEET MSL)

NC WATER LEVEL NOT CALCULATED DUE TO THE PRESENCE OF FREE PRODUCT IN WELL

2.0 WATER-LEVEL ELEVATION CONTOUR (FEET MSL) (CONTOUR INTERVAL = 0.5 FOOT)

NOTES:

1) ALL WATER LEVELS WERE MEASURED ON JULY 15, 1992.

2) WATER-LEVEL ELEVATION CONTOUR MAPS ARE BASED ON ONE INTERPRETATION OF THE DATA. OTHER INTERPRETATIONS ARE POSSIBLE.

3) BECAUSE FACILTY-WIDE GROUNDWATER LEVELS WERE TAKEN OVER A 6-HOUR PERIOD, GROUNDWATER CONTOURS MAY BE AFFECTED IN AREAS WITH TIDAL INFLUENCE.

400 0 400 800

SCALE IN FEET

DRAFT

NO.	DATE	REVISIONS	BY	CHK	DRAWN:	PROJECT NO: 11400 012302
					ENGINEER:	SCALE: 1"=400'
					CHECKED:	APPROVED:
					DATE:	DATE:

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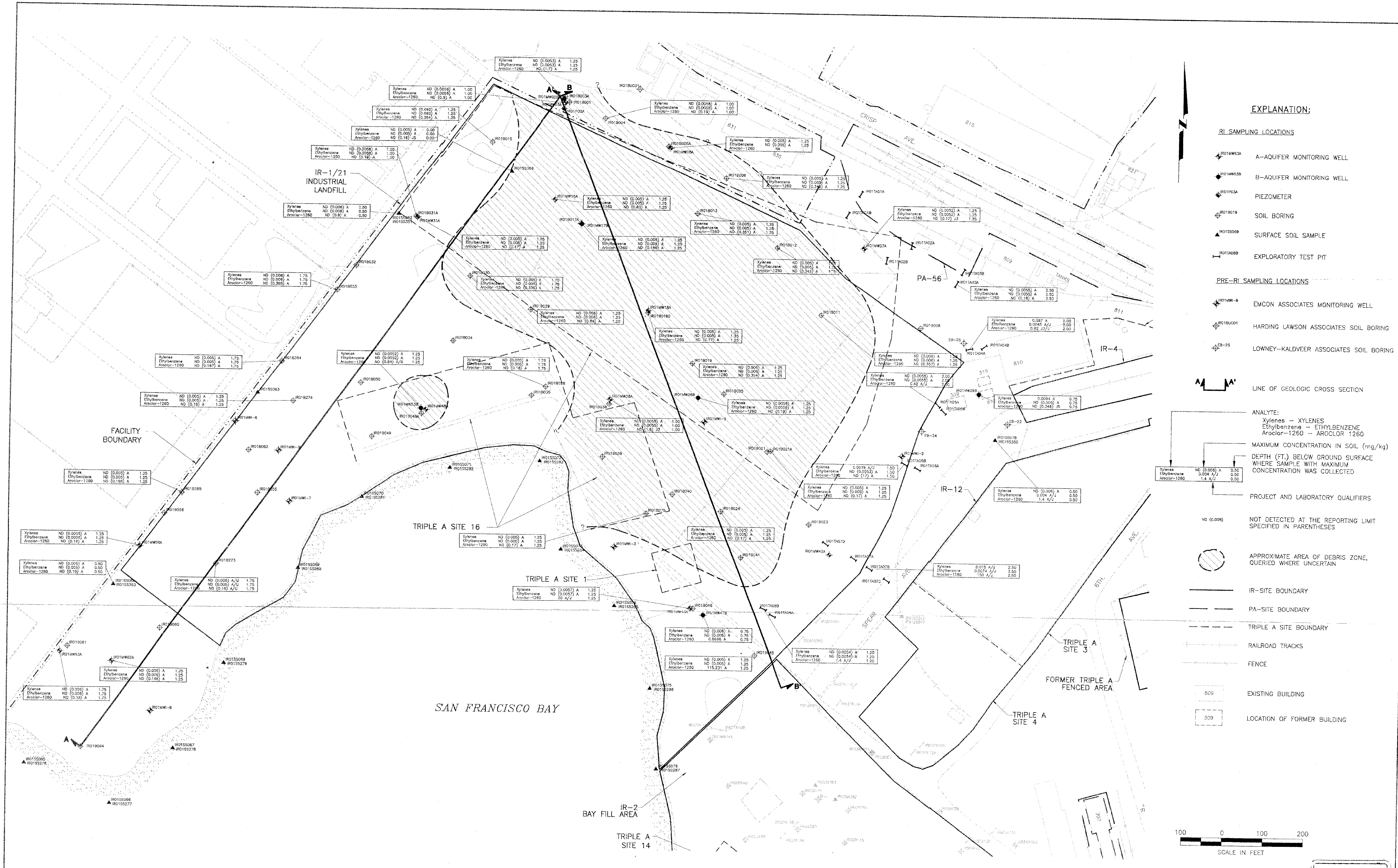
San Francisco, California

WATER-LEVEL ELEVATION CONTOUR MAP, A-AQUIFER JULY 1992

PLATE 14
SHEET: OF
REVISION NUMBER: A
DATE: 09/15/92

APPENDIX C

MAXIMUM CHEMICAL CONCENTRATIONS IN SOIL AT SITE IR-1/21



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NO.	DATE	REVISIONS	BY	CHK	

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ENGINEER:
CHECKED:
DATE:

PROJECT NO: 11400 012302
SCALE: 1"=100'
APPROVED:
DATE:

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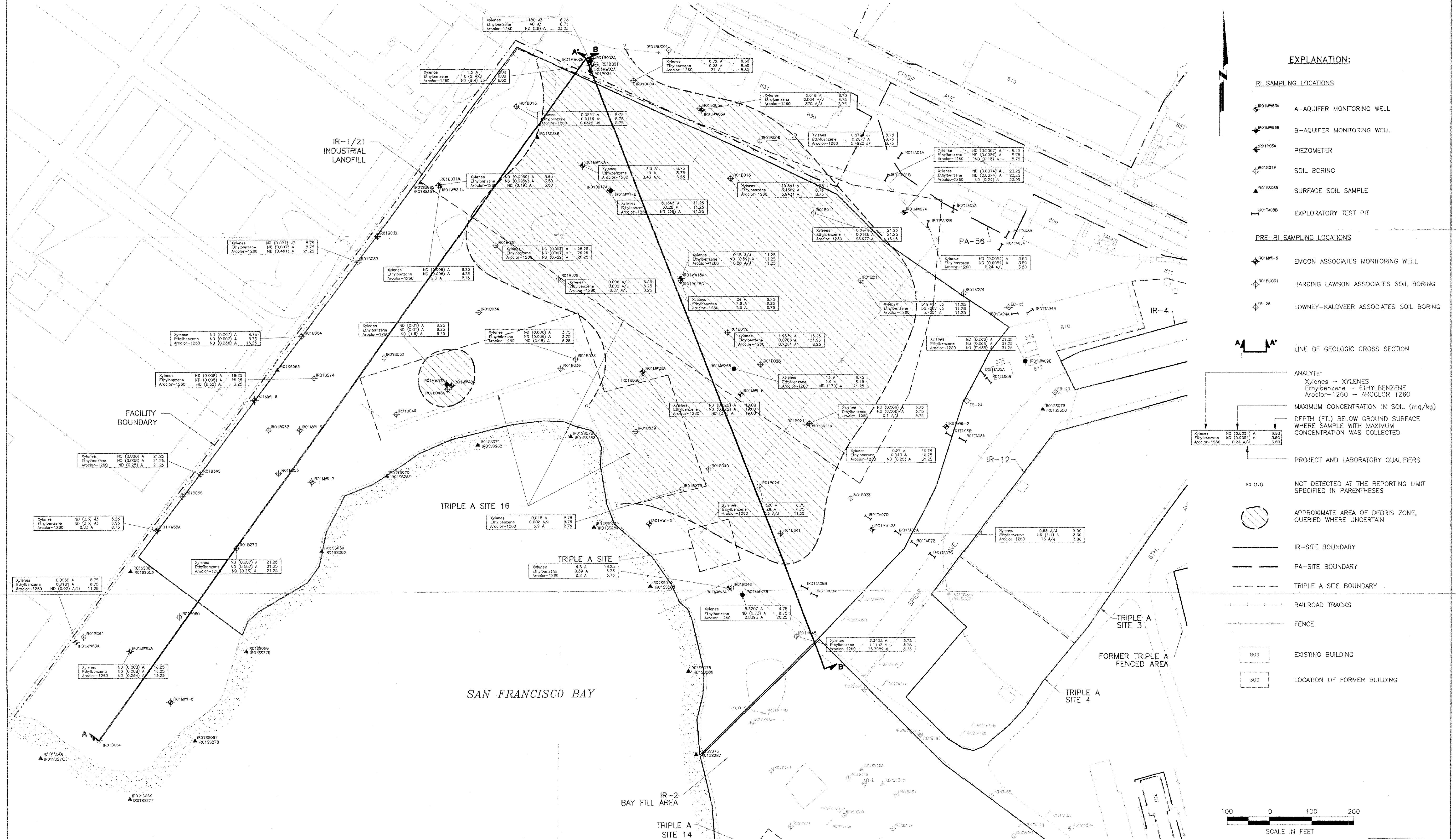
MAXIMUM XYLENES, ETHYLBENZENE, AND AROCLOR 1260 CONCENTRATIONS IN SOIL, 0- TO 2.5-FT. DEPTH INTERVAL, SITE IR-1/21

PLATE 15
SHEET: OF
REVISION NUMBER:
DATE: 5/93



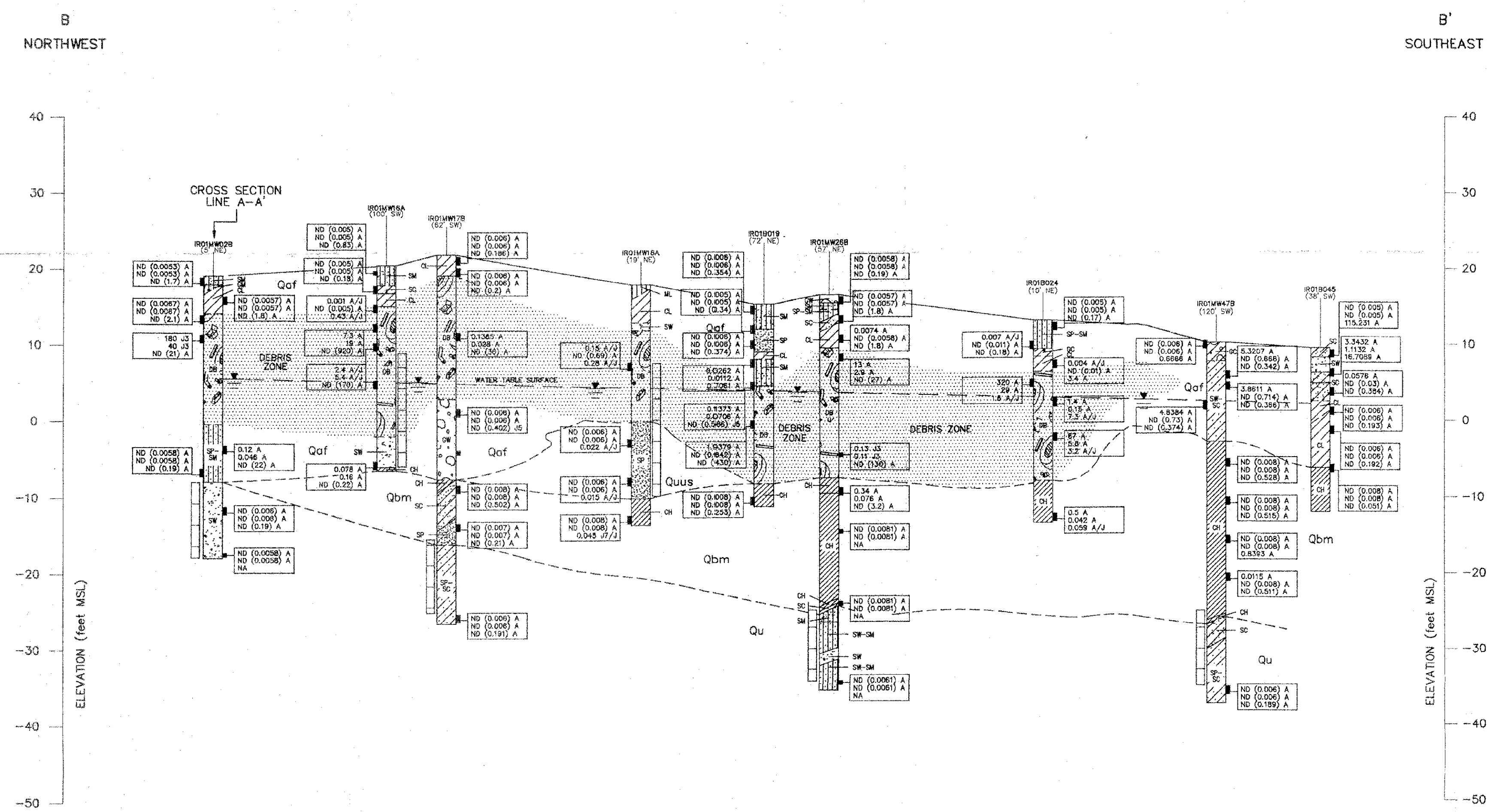
DRAFT

DRAWN:	PROJECT NO: 11400 012302	Harding Lawson Associates Engineering and Environmental Services	DEPARTMENT OF THE NAVY NAVAL FACILITIES ENGINEERING COMMAND WESTERN DIVISION San Bruno, California	PLATE 16
ENGINEER:	SCALE: 1"=100'		OU I Summary of Remedial Investigation Naval Station Treasure Island Hunters Point Annex San Francisco, California	SHEET: OF
CHECKED:	APPROVED:			REVISION NUMBER:
DATE:	DATE:			DATE: 5/93

NO. DATE REVISIONS BY CHK

MAXIMUM XYLENES, ETHYLBENZENE, AND AROCLOR 1260 CONCENTRATIONS IN SOIL, 2.51-FT. TO TOTAL DEPTH, SITE IR-1/21

31800



EXPLANATION:

CROSS SECTION LINE A-A' — INTERSECTION WITH OTHER CROSS SECTION; INTERPRETATIONS AT INTERSECTION POINTS ARE BASED ON BORING LOGS SHOWN ON THE CROSS SECTIONS AND THEREFORE MAY NOT MATCH INTERSECTING CROSS SECTION.

IR01MW02B (5' NE) — BORING OR WELL NUMBER (DISTANCE [in feet] AND DIRECTION FROM THE CROSS-SECTION LINE)

ACTUAL LOCATION OF BORING; THE DIAMETER OF THE LOG ON THE CROSS SECTION IS NOT TO SCALE.

SAMPLE INTERVAL

SCREEN INTERVAL

PROJECT AND LABORATORY QUALIFIERS

0.0576 A — XYLENES CONCENTRATION IN SOIL (mg/kg)
ND (0.03) A — ETHYLBENZENE CONCENTRATION IN SOIL (mg/kg)
ND (0.384) A — AROCLOR 1260 CONCENTRATION IN SOIL (mg/kg)

ND (2.15) — NOT DETECTED AT THE REPORTING LIMIT SPECIFIED IN PARENTHESES

NA — NOT ANALYZED

WATER LEVEL IN MONITORING WELL MEASURED ON 7/13/92

APPROXIMATE WATER TABLE SURFACE BASED ON INTERPRETATION OF WATER LEVELS IN MONITORING WELLS MEASURED ON 7/13/92; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

INTERPRETED CONTACT OF GEOLOGIC UNITS; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

Qaf — QUATERNARY ARTIFICIAL FILL
Quus — QUATERNARY UNDIFFERENTIATED UPPER SAND DEPOSITS
Qbm — QUATERNARY BAY MUD DEPOSITS
Qu — QUATERNARY UNDIFFERENTIATED SEDIMENTARY DEPOSITS

DEBRIS ZONE

NOTES:

1) THE ASTM SOIL CLASSIFICATIONS ARE SHOWN ON PLATE 12; THE LOCATION OF THE CROSS SECTION IS SHOWN ON PLATE 2.

2) THE CROSS SECTION IS ONE INTERPRETATION OF THE LITHOLOGIC DATA AND IS BASED ON THE DETAILED REVIEW OF THE BORING LOGS; OTHER INTERPRETATIONS MAY BE POSSIBLE. CONTACTS ARE INFERRED AND QUERIED WHERE UNCERTAIN.

100 0 100 200
SCALE IN FEET
VERTICAL EXAGGERATION = 10x

DRAFT

NO. DATE	REVISIONS	BY	CHK
DRAWN: JEB	PROJECT NO: 11400 012302		
ENGINEER:	SCALE: AS SHOWN		
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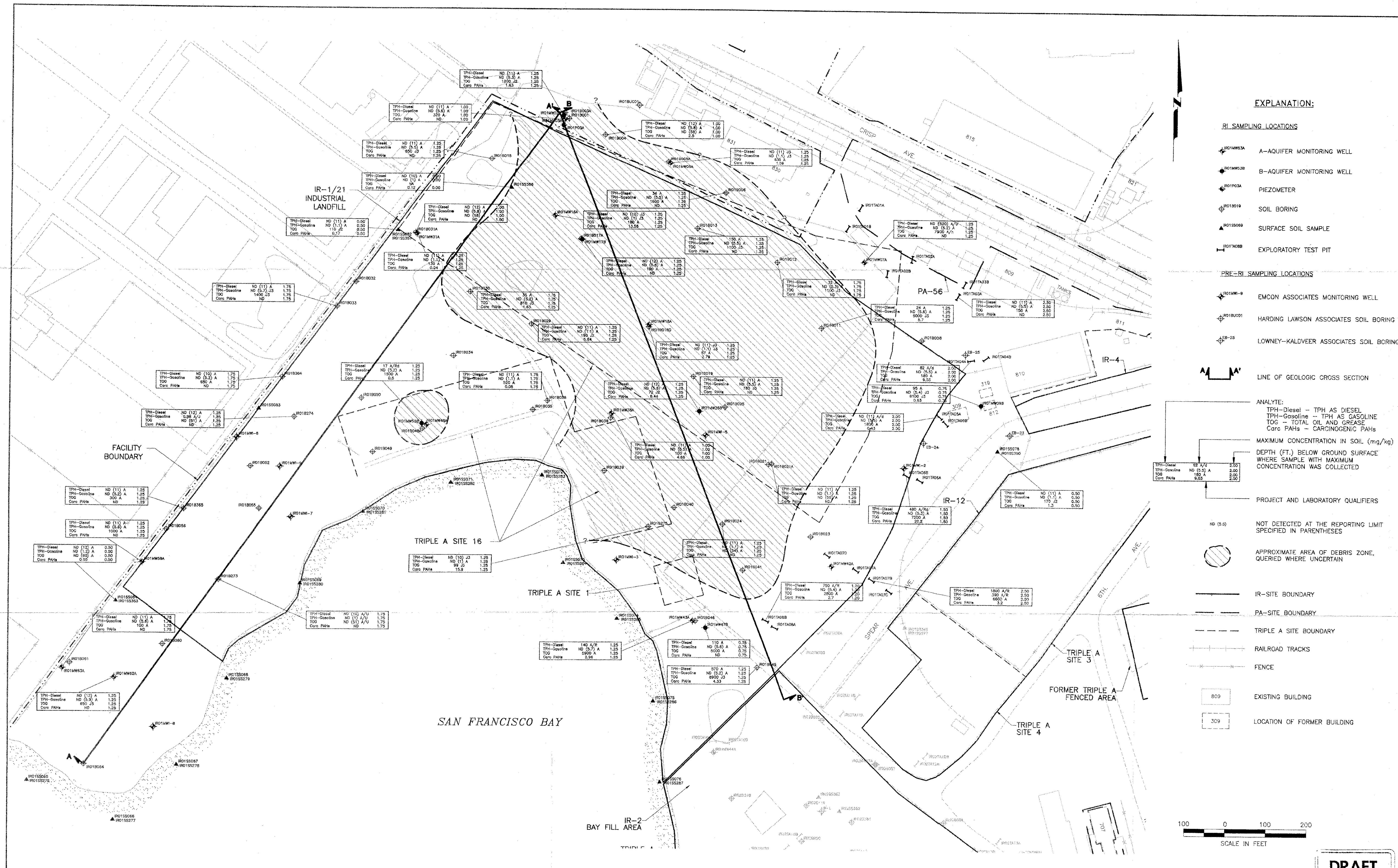
GEOLOGIC CROSS SECTION B-B' SHOWING XYLENES, ETHYLBENZENE, AND AROCLOR 1260 CONCENTRATIONS IN SOIL

PLATE 18
SHEET: OF
REVISION NUMBER:
DATE: 5/93



NO.	DATE	REVISIONS	BY	CHK
A	4/93		CSN	

DRAWN: | PROJECT NO: 11400 012302
ENGINEER: | SCALE: 1"=100'
CHECKED: | APPROVED:
DATE: | DATE:

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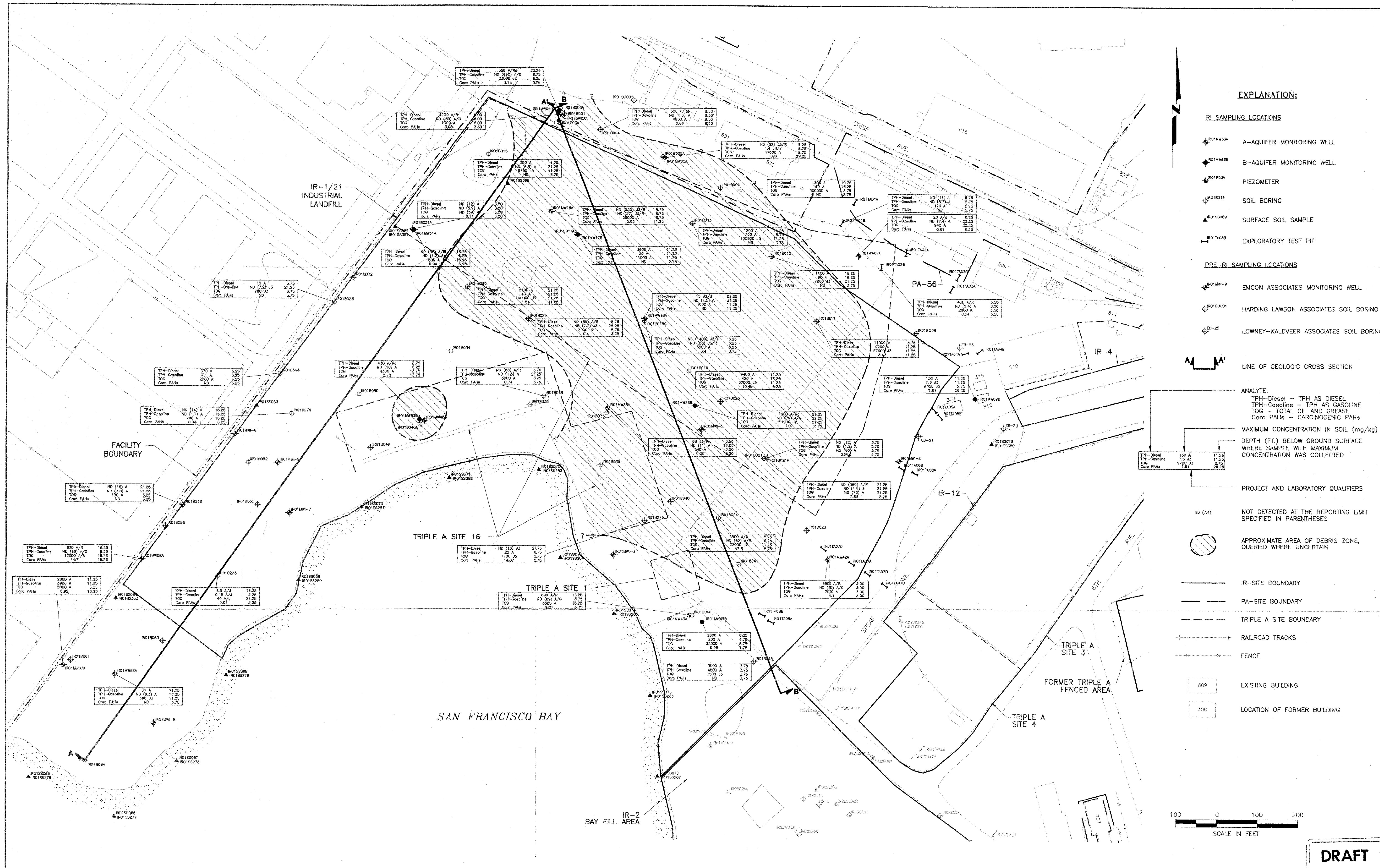
MAXIMUM TPH-DIESEL, TPH-GASOLINE, TOG, AND CARCINOGENIC PAH CONCENTRATIONS IN SOIL, 0- TO 2.5-FT. DEPTH INTERVAL, SITE IR-1/21

PLATE 19
SHEET: OF
REVISION NUMBER:
DATE:



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					CHECKED:	APPROVED:	
NO.	DATE	REVISIONS	BY	CHK	DATE:	DATE:	

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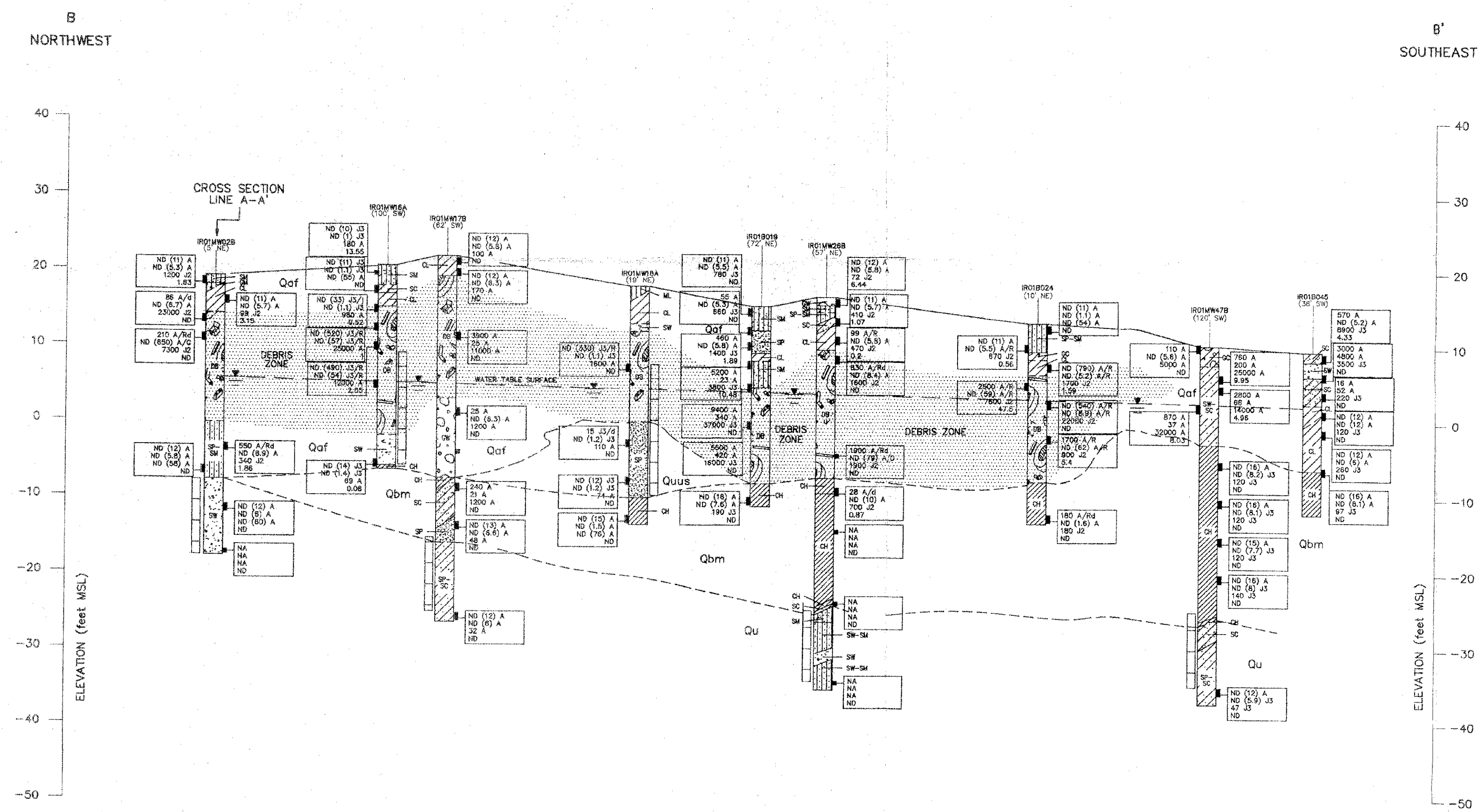
San Francisco, California

MAXIMUM TPH-DIESEL, TPH-GASOLINE, TOG, AND CARCINOGENIC PAH CONCENTRATIONS IN SOIL, 2.51-FT. TO TOTAL DEPTH, SITE IR-1/21

PLATE 20
SHEET: OF
REVISION NUMBER:
DATE:

31804



EXPLANATION:

CROSS SECTION LINE A-A' — INTERSECTION WITH OTHER CROSS SECTION; INTERPRETATIONS AT INTERSECTION POINTS ARE BASED ON BORING LOGS SHOWN ON THE CROSS SECTIONS AND THEREFORE MAY NOT MATCH INTERSECTING CROSS SECTION.

IR01MW02B (5' NE) — BORING OR WELL NUMBER (DISTANCE [in feet] AND DIRECTION FROM THE CROSS-SECTION LINE)

ACTUAL LOCATION OF BORING; THE DIAMETER OF THE LOG ON THE CROSS SECTION IS NOT TO SCALE.

SAMPLE INTERVAL

SCREEN INTERVAL

570 A / ND (5.2) A / 6900 J3 / 4.33 —
PROJECT AND LABORATORY QUALIFIERS
TPH-DIESEL CONCENTRATION IN SOIL (mg/kg)
TPH-GAS CONCENTRATION IN SOIL (mg/kg)
TOG CONCENTRATION IN SOIL (mg/kg)
CARCINOGENIC PAHs CONCENTRATION IN SOIL (mg/kg)

ND (2.15) — NOT DETECTED AT THE REPORTING LIMIT SPECIFIED IN PARENTHESES

NA — NOT ANALYZED

WATER LEVEL IN MONITORING WELL MEASURED ON 7/13/92

APPROXIMATE WATER TABLE SURFACE BASED ON INTERPRETATION OF WATER LEVELS IN MONITORING WELLS MEASURED ON 7/13/92; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

INTERPRETED CONTACT OF GEOLOGIC UNITS; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN

DEBRIS ZONE

Qaf — QUATERNARY ARTIFICIAL FILL
Quus — QUATERNARY UNDIFFERENTIATED UPPER SAND DEPOSITS
Qbm — QUATERNARY BAY MUD DEPOSITS
Qu — QUATERNARY UNDIFFERENTIATED SEDIMENTARY DEPOSITS

NOTES:

1) THE ASTM SOIL CLASSIFICATIONS ARE SHOWN ON PLATE 12; THE LOCATION OF THE CROSS SECTION IS SHOWN ON PLATE 2.

2) THE CROSS SECTION IS ONE INTERPRETATION OF THE LITHOLOGIC DATA AND IS BASED ON THE DETAILED REVIEW OF THE BORING LOGS; OTHER INTERPRETATIONS MAY BE POSSIBLE. CONTACTS ARE INFERRED AND QUERIED WHERE UNCERTAIN.

100 0 100 200
SCALE IN FEET
VERTICAL EXAGGERATION = 10x

DRAFT

NO.	DATE	REVISIONS	BY	CHK

DRAWN: JEB — PROJECT NO: 11400 012302
ENGINEER: — SCALE: AS SHOWN
CHECKED: — APPROVED:
DATE: — DATE:

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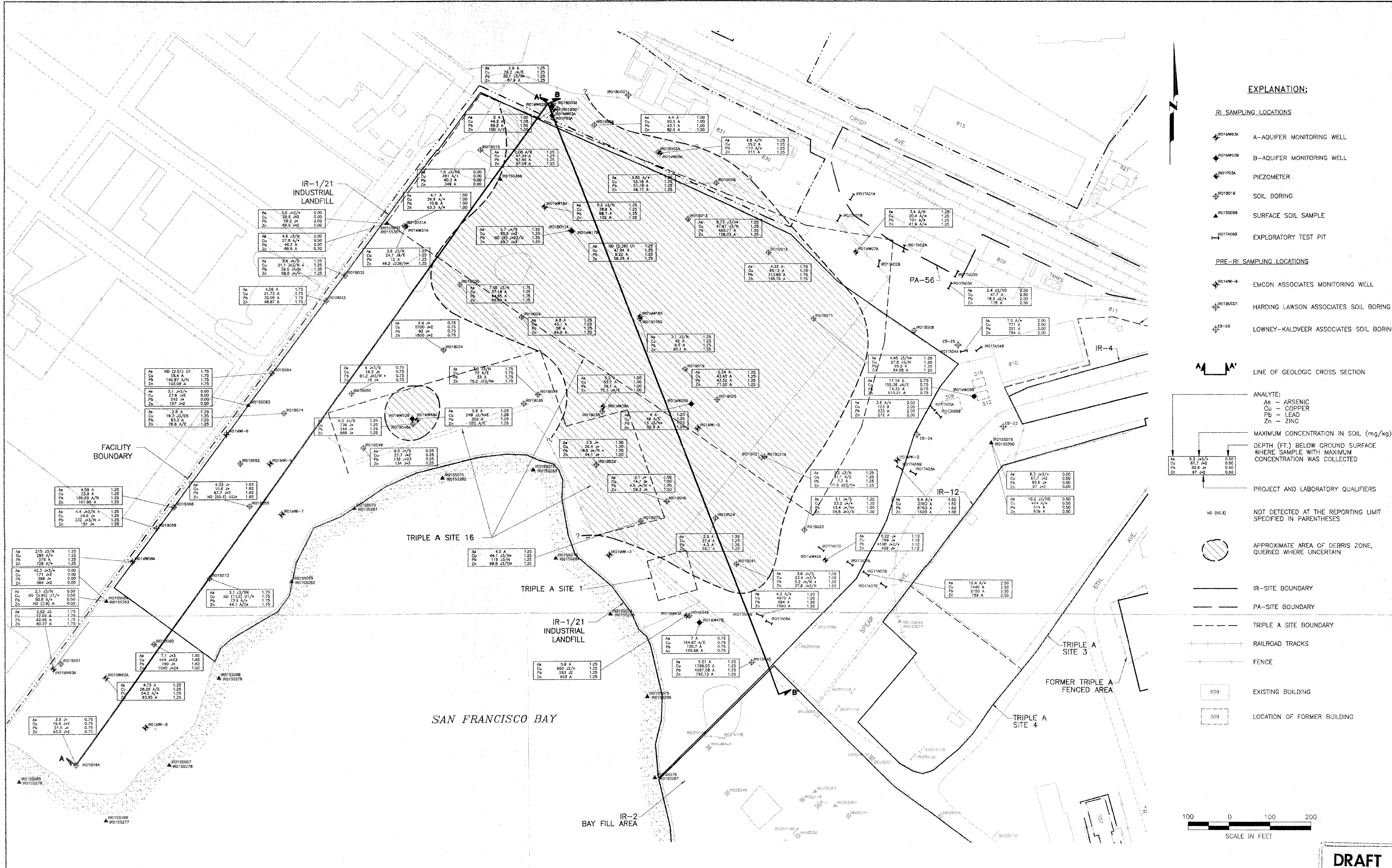
Naval Station Treasure Island
Hunters Point Annex
San Francisco, California

GEOLOGIC CROSS SECTION B-B' SHOWING TPH-DIESEL, TPH-GASOLINE, TOG, AND CARCINOGENIC PAH CONCENTRATIONS IN SOIL

PLATE 22
SHEET: OF
REVISION NUMBER:
DATE:



A 4/93			
NO. DATE	REVISIONS	BY	CHK

DRAWN: | PROJECT NO: 11400 012302
ENGINEER: | SCALE: 1"=100'
CHECKED: | APPROVED:
DATE: | DATE:

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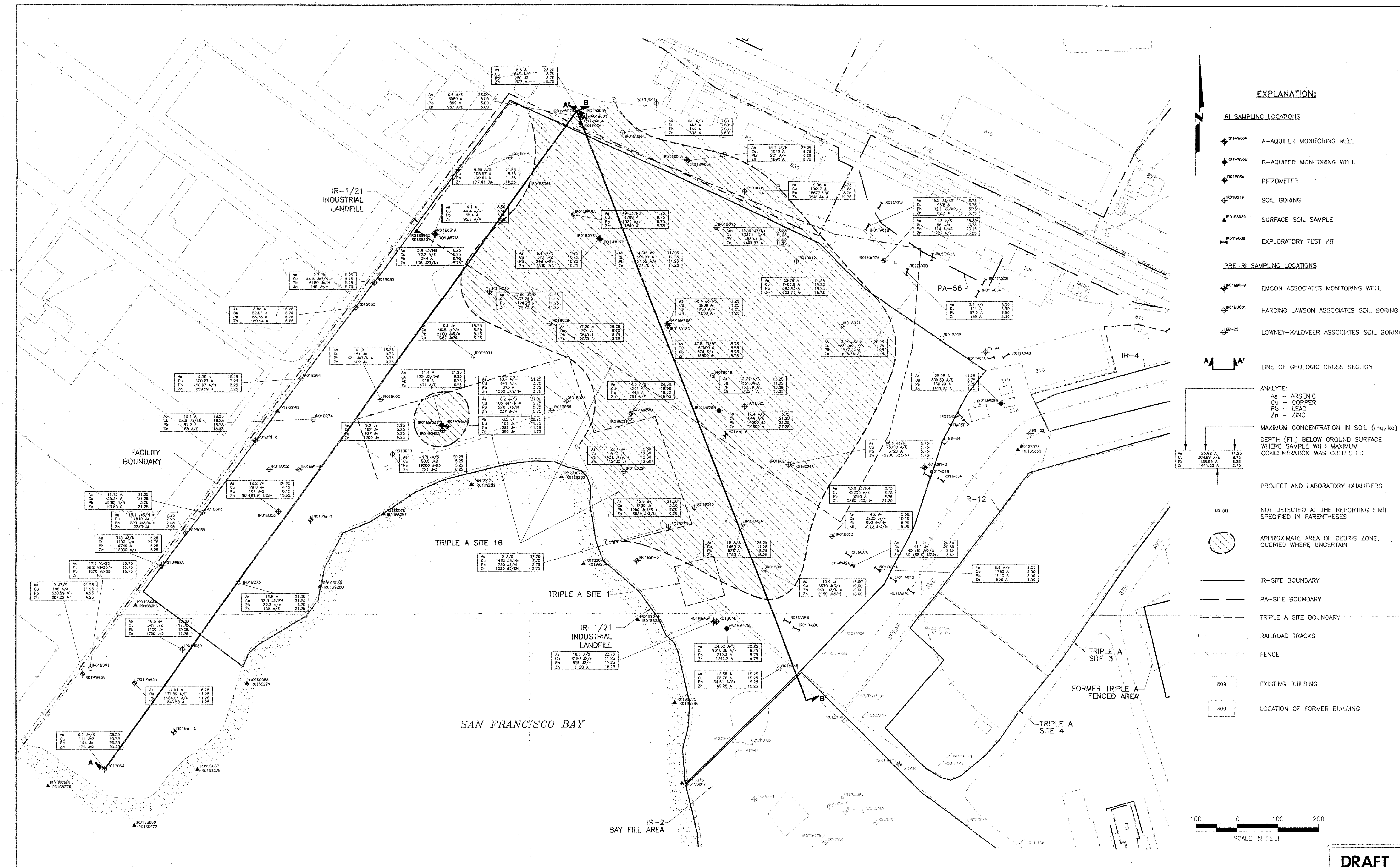
San Francisco, California

MAXIMUM ARSENIC, COPPER, LEAD, AND ZINC CONCENTRATIONS IN SOIL, 0- TO 2.5-FT. DEPTH INTERVAL, SITE IR-1/21

PLATE 23
SHEET: OF
REVISION NUMBER:
DATE: 4/93



DRAFT

A	4/93		CSN		
NO.	DATE	REVISIONS	BY	CHK	

DRAWN: | PROJECT NO: 11400 012302
ENGINEER: | SCALE: 1"=100'
CHECKED: | APPROVED:
DATE: | DATE:

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San Bruno, California

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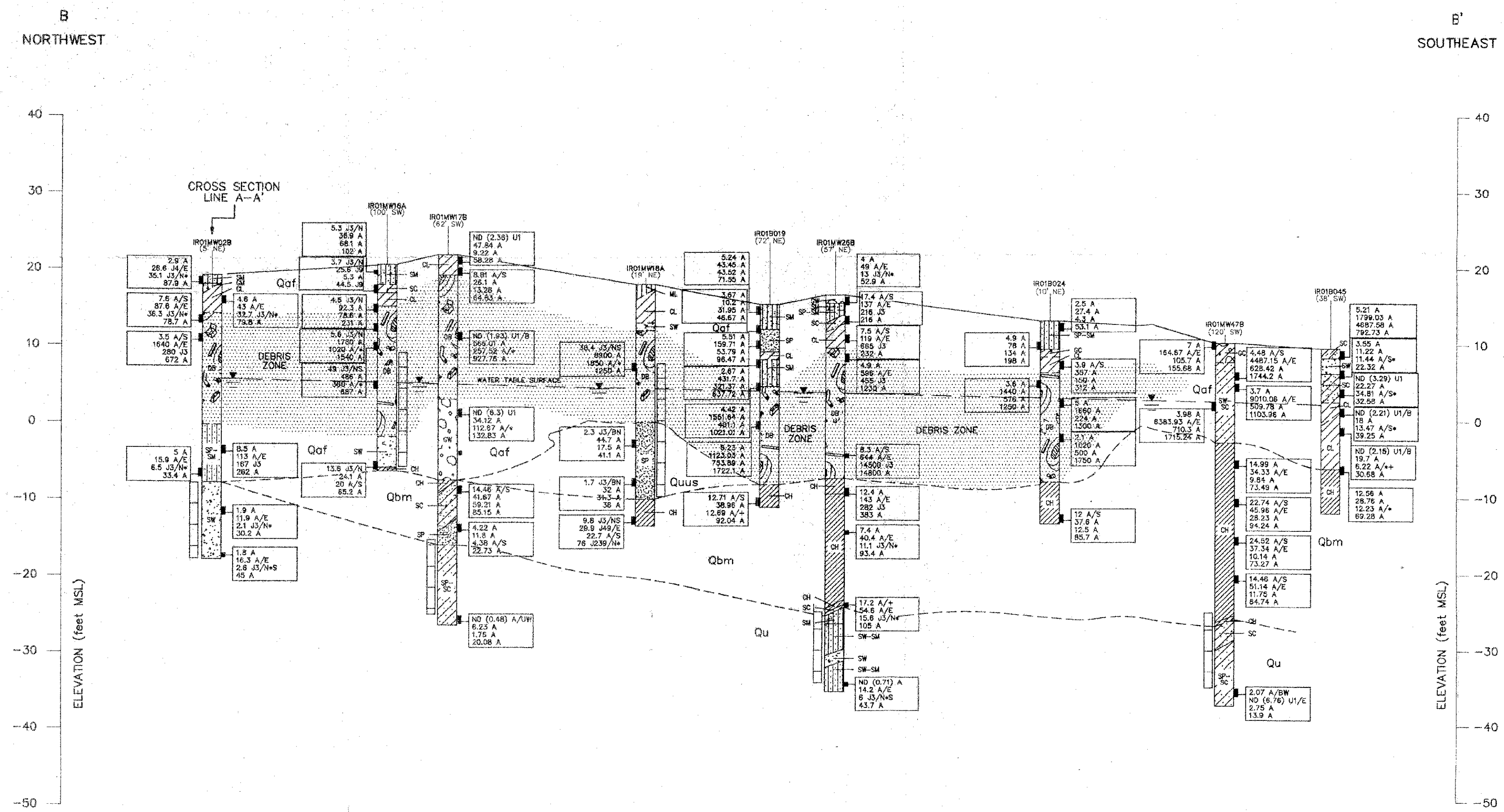
San Francisco, California

MAXIMUM ARSENIC, COPPER, LEAD, AND ZINC CONCENTRATIONS IN SOIL, 2.51-FT. TO TOTAL DEPTH, SITE IR-1/21

PLATE 24
SHEET: OF
REVISION NUMBER:
DATE: 4/93



EXPLANATION:

CROSS SECTION LINE A-A'	INTERSECTION WITH OTHER CROSS SECTION; INTERPRETATIONS AT INTERSECTION POINTS ARE BASED ON BORING LOGS SHOWN ON THE CROSS SECTIONS AND THEREFORE MAY NOT MATCH INTERSECTING CROSS SECTION.
IR01MW02B (5' NE)	BORING OR WELL NUMBER (DISTANCE [in feet] AND DIRECTION FROM THE CROSS-SECTION LINE)
	ACTUAL LOCATION OF BORING; THE DIAMETER OF THE LOG ON THE CROSS SECTION IS NOT TO SCALE.
■	SAMPLE INTERVAL
	SCREEN INTERVAL
ND (2.15) U1/B 19.7 A 6.22 A/++ 30.68 A	PROJECT AND LABORATORY QUALIFIERS ARSENIC CONCENTRATION IN SOIL (mg/kg) COPPER CONCENTRATION IN SOIL (mg/kg) LEAD CONCENTRATION IN SOIL (mg/kg) ZINC CONCENTRATION IN SOIL (mg/kg)
ND (2.15)	NOT DETECTED AT THE REPORTING LIMIT SPECIFIED IN PARENTHESES
NA	NOT ANALYZED
	WATER LEVEL IN MONITORING WELL MEASURED ON 7/13/92
— —?— —	APPROXIMATE WATER TABLE SURFACE BASED ON INTERPRETATION OF WATER LEVELS IN MONITORING WELLS MEASURED ON 7/13/92; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN
— —?— — —?— —	INTERPRETED CONTACT OF GEOLOGIC UNITS; DASHED WHERE INFERRED AND QUERIED WHERE UNCERTAIN
	DEBRIS ZONE
Qaf	QUATERNARY ARTIFICIAL FILL
Quus	QUATERNARY UNDIFFERENTIATED UPPER SAND DEPOSITS
Qbm	QUATERNARY BAY MUD DEPOSITS
Qu	QUATERNARY UNDIFFERENTIATED SEDIMENTARY DEPOSITS

NOTES:

1) THE ASTM SOIL CLASSIFICATIONS ARE SHOWN ON PLATE 12; THE LOCATION OF THE CROSS SECTION IS SHOWN ON PLATE 2.

2) THE CROSS SECTION IS ONE INTERPRETATION OF THE LITHOLOGIC DATA AND IS BASED ON THE DETAILED REVIEW OF THE BORING LOGS; OTHER INTERPRETATIONS MAY BE POSSIBLE. CONTACTS ARE INFERRED AND QUERIED WHERE UNCERTAIN.

100 0 100 200

SCALE IN FEET

VERTICAL EXAGGERATION = 10x

DRAFT

NO.	DATE	REVISIONS	BY	CHK
A	12/14		GK	
B	2/4		CSN	
C	4/20		JEB	

DRAWN: GK | PROJECT NO: 11400 012302
ENGINEER: | SCALE: AS SHOWN
CHECKED: | APPROVED:
DATE: | DATE:

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San Francisco, California

GEOLOGIC CROSS SECTION B-B' SHOWING ARSENIC, COPPER, LEAD, AND ZINC CONCENTRATIONS IN SOIL

PLATE 26
SHEET: OF
REVISION NUMBER: 0
DATE: 5/25/93

APPENDIX D

SITE IR-1/21 GROUNDWATER DATA IN WELLS NEAR THE BAY

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
IR01MW43A	5.0 - 22.5	22-Mar-91	1,1-DICHLOROETHANE	12	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	1,3-DICHLOROBENZENE	13	J5	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	1,3-DICHLOROBENZENE	6	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	1,3-DICHLOROBENZENE	8	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	1,3-DICHLOROBENZENE	7	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	1,4-DICHLOROBENZENE	16	J5	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	1,4-DICHLOROBENZENE	8	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	1,4-DICHLOROBENZENE	5	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	1,4-DICHLOROBENZENE	7	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	1,4-DICHLOROBENZENE	7	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	1,4-DICHLOROBENZENE	13	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	1,4-DICHLOROBENZENE	11	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	1,4-DICHLOROBENZENE	7	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	2,4-DIMETHYLPHENOL	13	J5	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	2,4-DIMETHYLPHENOL	8	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	2-METHYLNAPHTHALENE	4.7	J5	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	2-METHYLNAPHTHALENE	8	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	2-METHYLNAPHTHALENE	4	J7	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	2-METHYLNAPHTHALENE	4	J7	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	2-METHYLPHENOL	7.7	J5	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	4-CHLORO-3-METHYLPHENOL	14	J5	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	4-METHYL-2-PENTANONE	3.8	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	4-METHYLPHENOL	11	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	4-METHYLPHENOL	5	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	4-METHYLPHENOL	7	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	ACETONE	28	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	ACETONE	35	A	UG/L
IR01MWI-8	2.0 - 12.0	21-Aug-92	ACETONE	66	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	AROCLOR-1260	37	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	AROCLOR-1260	34	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	AROCLOR-1260	20	J3	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	AROCLOR-1260	11	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	AROCLOR-1260	2.7	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	AROCLOR-1260	7.1	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	AROCLOR-1260	13	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	AROCLOR-1260	54	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	AROCLOR-1260	6.2	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	AROCLOR-1260	32	J3	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	AROCLOR-1260	19	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	AROCLOR-1260	11	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	BENZENE	2	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	BENZENE	44	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	BENZENE	9	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	BENZENE	6	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	BENZENE	3	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	BENZENE	3	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZENE	5	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZENE	5	A	UG/L
IR01MW48A	5.0 - 18.0	09-Jul-92	BENZENE	3	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	BENZENE	12	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	BENZENE	14	A	UG/L
IR01MW38A	7.0 - 20.0	18-Aug-92	BENZENE	1	A	UG/L
IR01MW48A	5.0 - 18.0	19-Aug-92	BENZENE	4	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	BENZENE	9	A	UG/L

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZO(A)ANTHRACENE	2	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZO(A)ANTHRACENE	3	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	BENZO(A)ANTHRACENE	5	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZO(A)PYRENE	2	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZO(A)PYRENE	2	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	BENZO(A)PYRENE	3	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZO(B)FLUORANTHENE	3	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	BENZO(B)FLUORANTHENE	3	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	BENZO(B)FLUORANTHENE	6	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	BENZO(G,H,I)PERYLENE	3	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	BENZOIC ACID	5	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	BENZOIC ACID	5	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	BIS(2-ETHYLHEXYL)PHTHALATE	83	J5	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	BIS(2-ETHYLHEXYL)PHTHALATE	2.5	A	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	CARBON DISULFIDE	8	A	UG/L
IR01MWI-8	2.0 - 12.0	21-Aug-92	CARBON DISULFIDE	1	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	CHLOROBENZENE	2	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	CHLOROBENZENE	1.4	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	CHLOROBENZENE	11	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	CHLOROBENZENE	2	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	CHLOROBENZENE	12	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	CHLOROBENZENE	8	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	CHLOROBENZENE	2	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	CHLOROBENZENE	2	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	CHLOROBENZENE	1	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	CHLOROBENZENE	2	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	CHLOROBENZENE	13	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	CHLOROETHANE	10	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	CHRYSENE	10	J5	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	CHRYSENE	2	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	CHRYSENE	3	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	CHRYSENE	3	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	CHRYSENE	3	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	CHRYSENE	5	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	DI-N-OCTYLPHTHALATE	3	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	ETHYLBENZENE	1.2	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	ETHYLBENZENE	10	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	ETHYLBENZENE	4	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	ETHYLBENZENE	4	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	FLUORANTHENE	3.4	J5	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	FLUORANTHENE	6	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	FLUORANTHENE	6	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	FLUORANTHENE	13	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	FLUORENE	2	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	FLUORENE	3	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	FLUORIDE	0.73	A	MG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	INDENO(1,2,3-CD)PYRENE	3	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	METHYLENE CHLORIDE	1.8	A	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	METHYLENE CHLORIDE	2	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	NAPHTHALENE	4.9	J5	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	NAPHTHALENE	6.3	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	NAPHTHALENE	6.2	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	NAPHTHALENE	14	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	NAPHTHALENE	5	A	UG/L

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
IR01MW48A	5.0 - 18.0	22-Jan-92	NAPHTHALENE	6	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	NAPHTHALENE	7	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	NAPHTHALENE	2	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	NAPHTHALENE	8	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	NAPHTHALENE	9	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	NAPHTHALENE	7	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	NAPHTHALENE	7	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	ORTHOPHOSPHATE AS P	5.4	A	MG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	ORTHOPHOSPHATE AS P	0.72	A	MG/L
IR01MW38A	7.0 - 20.0	07-May-91	ORTHOPHOSPHATE AS P	0.32	A	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	PHENANTHRENE	4	J5	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	PHENANTHRENE	2	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	PHENANTHRENE	3	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	PHENOL	67	J5	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	PHENOL	5.5	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	PHENOL	5	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	PHENOL	60	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	PHENOL	6	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	PHENOL	7	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	PHENOL	50	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	PHENOL	41	A	UG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	PHENOL	10	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	PHENOL	2	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	PHOSPHATE	0.14	A	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	PYRENE	3.4	J5	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	PYRENE	4	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	PYRENE	4	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	PYRENE	10	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	TETRACHLOROETHENE	1.5	A	UG/L
IR01MWI-3	4.0 - 17.0	06-Jul-92	TETRACHLOROETHENE	1	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	TOLUENE	1.6	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	TOLUENE	6	A	UG/L
IR01MWI-7	3.0 - 13.0	10-Jul-92	TOLUENE	2	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	TOLUENE	5	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	TOLUENE	4	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	TOTAL DISSOLVED SOLIDS	748	J5	MG/L
IR01MW44A	4.0 - 8.0	20-Aug-92	TOTAL DISSOLVED SOLIDS	1390	A	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	TPH-DIESEL	2200	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	TPH-DIESEL	910	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	TPH-DIESEL	1000	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	TPH-DIESEL	780	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	TPH-DIESEL	5200	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	TPH-EXTRACTABLE UNKNOWN HYDROC	4000	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	TPH-EXTRACTABLE UNKNOWN HYDROC	310	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	TPH-EXTRACTABLE UNKNOWN HYDROC	0.84	A	MG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	TPH-EXTRACTABLE UNKNOWN HYDROC	1.3	A	MG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	TPH-EXTRACTABLE UNKNOWN HYDROC	1.4	A	MG/L
IR01MW48A	5.0 - 18.0	09-Jul-92	TPH-EXTRACTABLE UNKNOWN HYDROC	1.4	A	MG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	TPH-EXTRACTABLE UNKNOWN HYDROC	5.8	A	MG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	TPH-EXTRACTABLE UNKNOWN HYDROC	5.7	A	MG/L
IR01MW38A	7.0 - 20.0	18-Aug-92	TPH-EXTRACTABLE UNKNOWN HYDROC	0.89	A	MG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	TPH-GASOLINE	1100	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	TRICHLOROETHENE	1.1	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	XYLENE (TOTAL)	41	A	UG/L

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
IR01MW43A	5.0 - 22.5	09-Jan-92	XYLENE (TOTAL)	160	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	XYLENE (TOTAL)	4	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	XYLENE (TOTAL)	170	A	UG/L
IR01MW43A	5.0 - 22.5	18-Aug-92	XYLENE (TOTAL)	140	A	UG/L
IR01MWI-3	4.0 - 17.0	24-Aug-92	XYLENE (TOTAL)	2	A	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	ALUMINUM	105	J*5	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	ANTIMONY	38.6	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	ANTIMONY	27.1	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	ANTIMONY	22.8	J*	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	ARSENIC	22.5	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	ARSENIC	18.4	J*3	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	ARSENIC	7.2	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	ARSENIC	3.2	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	ARSENIC	3	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	ARSENIC	2.5	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	ARSENIC	1.8	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	ARSENIC	1.8	J3	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	BARIUM	1880	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	BARIUM	1820	A	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	BARIUM	1300	J*35	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	BARIUM	789	J*	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	BARIUM	710	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	BARIUM	424	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	BARIUM	375	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	BARIUM	341	J*2	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	BARIUM	339	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	BARIUM	263	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	BARIUM	180	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	BARIUM	136	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	BARIUM	97.1	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	BARIUM	94.6	J4	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	BARIUM	56.8	A	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	BERYLLIUM	2.9	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	BERYLLIUM	2.3	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	BERYLLIUM	0.43	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	BERYLLIUM	0.32	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	BERYLLIUM	0.32	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	CALCIUM	288000	A	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	CALCIUM	281000	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	CALCIUM	236000	J*	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	CALCIUM	149000	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	CALCIUM	143000	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	CALCIUM	137000	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	CALCIUM	136000	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	CALCIUM	115000	J4	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	CALCIUM	113000	J*5	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	CALCIUM	111000	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	CALCIUM	105000	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	CALCIUM	101000	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	CALCIUM	92600	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	CALCIUM	71600	J*	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	CALCIUM	56200	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	CHLORIDE	15200	A	MG/L

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
IR01MWI-7	3.0 - 13.0	22-Oct-90	CHLORIDE	13400	A	MG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	CHLORIDE	12100	A	MG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	CHLORIDE	3440	A	MG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	CHLORIDE	2960	A	MG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	CHLORIDE	2900	A	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	CHLORIDE	1550	A	MG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	CHLORIDE	1280	A	MG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	CHLORIDE	371	A	MG/L
IR01MW38A	7.0 - 20.0	07-May-91	CHLORIDE	287	A	MG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	CHLORIDE	208	A	MG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	CHLORIDE	204	A	MG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	CHLORIDE	590	A	MG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	CHLORIDE	400	A	MG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	CHLORIDE	33.7	A	MG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	CHROMIUM	23.8	J*3	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	CHROMIUM	22.9	J*	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	CHROMIUM	15.5	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	CHROMIUM	14.7	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	CHROMIUM	13.7	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	CHROMIUM	2.9	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	CHROMIUM	2.4	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	COBALT	9.7	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	COBALT	6.6	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	COPPER	21.9	J*	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	COPPER	6.5	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	COPPER	3.7	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	COPPER	2.2	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	CYANIDE	17	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	CYANIDE	0.022	A	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	FLUORIDE	2	J5	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	FLUORIDE	1	A	MG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	FLUORIDE	0.65	A	MG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	FLUORIDE	0.6	A	MG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	IRON	5400	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	IRON	5100	J*	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	IRON	3220	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	IRON	2440	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	IRON	2260	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	IRON	2180	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	IRON	1460	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	IRON	722	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	IRON	412	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	IRON	180	J*	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	IRON	147	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	IRON	139	A	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	IRON	48	J*5	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	LEAD	1	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	LEAD	1	A	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	MAGNESIUM	843000	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	MAGNESIUM	817000	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	MAGNESIUM	458000	J*	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	MAGNESIUM	314000	J*	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	MAGNESIUM	242000	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	MAGNESIUM	218000	A	UG/L

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
======	=======	======	====================	======	====	===
IR01MW43A	5.0 - 22.5	22-Mar-91	MAGNESIUM	204000	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	MAGNESIUM	153000	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	MAGNESIUM	144000	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	MAGNESIUM	84800	A	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	MAGNESIUM	80500	J*5	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	MAGNESIUM	78900	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	MAGNESIUM	32200	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	MAGNESIUM	27100	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	MAGNESIUM	25700	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	MANGANESE	1510	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	MANGANESE	1330	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	MANGANESE	1040	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	MANGANESE	1010	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	MANGANESE	874	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	MANGANESE	859	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	MANGANESE	804	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	MANGANESE	680	J*	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	MANGANESE	430	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	MANGANESE	181	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	MANGANESE	180	A	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	MANGANESE	168	J*35	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	MANGANESE	121	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	MANGANESE	84.6	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	MANGANESE	80	J*	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	MOLYBDENUM	8.8	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	NICKEL	74.7	J*	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	NICKEL	51.2	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	NICKEL	28.4	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	NICKEL	22.4	J3	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	PH	8.3	A	PH
IR01MW48A	5.0 - 18.0	22-Jan-92	PH	7.9	A	PH
IR01MW48A	5.0 - 18.0	22-Jan-92	PH	7.9	A	PH
IR01MWI-7	3.0 - 13.0	21-Jan-92	PH	7.6	A	PH
IR01MW43A	5.0 - 22.5	09-Jan-92	PH	7.5	J5	PH
IR01MWI-8	2.0 - 12.0	27-Jan-92	PH	7.5	A	PH
IR01MW38A	7.0 - 20.0	07-May-91	PH	7.4	A	PH
IR01MW44A	4.0 - 8.0	20-Jan-92	PH	7.4	A	PH
IR01MWI-7	3.0 - 13.0	22-Oct-90	PH	7.3	J5	PH
IR01MWI-3	4.0 - 17.0	16-Jan-92	PH	7.2	A	PH
IR01MWI-3	4.0 - 17.0	23-Oct-90	PH	7.2	J5	PH
IR01MW38A	7.0 - 20.0	16-Jan-92	PH	7.1	A	PH
IR01MWI-3	4.0 - 17.0	16-Jan-92	PHOSPHATE	0.59	A	MG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	PHOSPHATE	0.38	A	MG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	POTASSIUM	296000	A	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	POTASSIUM	260000	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	POTASSIUM	158000	J*	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	POTASSIUM	83400	A	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	POTASSIUM	79900	J*5	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	POTASSIUM	70700	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	POTASSIUM	65400	J*	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	POTASSIUM	63000	A	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	POTASSIUM	62800	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	POTASSIUM	52900	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	POTASSIUM	16600	A	UG/L

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
IR01MW38A	7.0 - 20.0	16-Jan-92	POTASSIUM	15900	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	POTASSIUM	13600	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	POTASSIUM	10500	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	POTASSIUM	9930	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	SELENIUM	25	J*	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	SILVER	1.9	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	SODIUM	8210000	A	UG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	SODIUM	7210000	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	SODIUM	7000000	J*	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	SODIUM	1990000	A	UG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	SODIUM	1940000	J*5	UG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	SODIUM	1930000	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	SODIUM	1010000	A	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	SODIUM	997000	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	SODIUM	895500	J*	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	SODIUM	718000	A	UG/L
IR01MW38A	7.0 - 20.0	07-May-91	SODIUM	445000	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	SODIUM	365000	A	UG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	SODIUM	179000	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	SODIUM	104000	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	SODIUM	97500	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	SULFATE	2230	A	MG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	SULFATE	772	A	MG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	SULFATE	646	A	MG/L
IR01MW38A	7.0 - 20.0	07-May-91	SULFATE	507	A	MG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	SULFATE	231	A	MG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	SULFATE	167	A	MG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	SULFATE	165	A	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	SULFATE	130	A	MG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	SULFATE	38	A	MG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	SULFATE	16.9	A	MG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	SULFATE	13	A	MG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	SULFATE	12.4	A	MG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	SULFATE	10.8	A	MG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	TOTAL DISSOLVED SOLIDS	28600	A	MG/L
IR01MWI-7	3.0 - 13.0	21-Jan-92	TOTAL DISSOLVED SOLIDS	23600	A	MG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	TOTAL DISSOLVED SOLIDS	17830	J5	MG/L
IR01MW48A	5.0 - 18.0	30-Oct-90	TOTAL DISSOLVED SOLIDS	6950	J5	MG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	TOTAL DISSOLVED SOLIDS	5760	A	MG/L
IR01MW48A	5.0 - 18.0	22-Jan-92	TOTAL DISSOLVED SOLIDS	5730	A	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	TOTAL DISSOLVED SOLIDS	4360	A	MG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	TOTAL DISSOLVED SOLIDS	4000	A	MG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	TOTAL DISSOLVED SOLIDS	3526	J5	MG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	TOTAL DISSOLVED SOLIDS	3300	A	MG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	TOTAL DISSOLVED SOLIDS	2280	A	MG/L
IR01MW44A	4.0 - 8.0	20-Jan-92	TOTAL DISSOLVED SOLIDS	995	A	MG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	TOTAL DISSOLVED SOLIDS	695	J5	MG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	VANADIUM	24.7	A	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	VANADIUM	10.3	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	VANADIUM	8.4	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	VANADIUM	6.8	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	VANADIUM	5.8	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	VANADIUM	4.3	A	UG/L
IR01MWI-8	2.0 - 12.0	27-Jan-92	VANADIUM	3.2	A	UG/L

Site IR-1/21 Groundwater Data from Monitoring Wells Near the Bay

Location	Aquifer Sreen Depth	Sample Date	Chemical Parameter	Result	Qual	Units
IR01MW44A	4.0 - 8.0	25-Mar-91	ZINC	235	A	UG/L
IR01MW44A	4.0 - 8.0	25-Mar-91	ZINC	226	A	UG/L
IR01MWI-3	4.0 - 17.0	23-Oct-90	ZINC	78	J*3	UG/L
IR01MW43A	5.0 - 22.5	22-Mar-91	ZINC	66.3	A	UG/L
IR01MWI-7	3.0 - 13.0	22-Oct-90	ZINC	42	J*	UG/L
IR01MW43A	5.0 - 22.5	09-Jan-92	ZINC	36.1	A	UG/L
IR01MWI-3	4.0 - 17.0	16-Jan-92	ZINC	19	A	UG/L
IR01MW38A	7.0 - 20.0	16-Jan-92	ZINC	5.6	A	UG/L

PROJECT AND LABORATORY QUALIFIERS ASSIGNED DURING THE RI

Project Qualifiers

J Qualifiers

Analytical results that receive a "J" are qualified as estimated due to noncompliance with the following criteria.

J0 - Internal standard
J1 - Instrument performance
J2 - Laboratory duplicate precision
J3 - Laboratory spike recovery
J4 - ICP serial dilution
J5 - Holding time
J6 - Field duplicate precision
J7 - Initial and/or continuing calibration
J8 - Result above the calibration range
J9 - ICP interference check sample
J* - Results of full validation

U Qualifiers

Analytical results that receive a "U" are qualified as nondetected for the following reasons:

U1 - Analyte detected in laboratory blanks
U2 - Analyte detected in field blanks
U4 - Analyte is a common laboratory contaminant, and after review of the data the analyte was qualified based on professional judgment

R Qualifiers

Analytical results that receive an "R" are qualified as rejected due to noncompliance with the following criteria:

R0 - Internal standard
R1 - Holding time
R2 - Laboratory spike recovery
R3 - Instrument performance
R5 - Analyte incorrectly identified
R6 - Results of full validation
R7 - Initial and/or continuing calibration
R8 - Field duplicate precision
R9 - ICP interference check sample

Other Qualifiers

A - Acceptable without qualification
V - Received a full CLP validation

Laboratory Qualifiers

Inorganic Analyses

B - Reported value is less than the CRDL and greater than the IDL
E - Serial dilution analysis was not within the control limits
N - Spiked sample recovery was not within control limits
S - Reported value was determined by the Method of Standard Additions
U - Analyte was not detected
W - Post-digestion spike for furnace AA was not within the control limits
* - Duplicate sample analysis was not within the control limits
+ - Correlation coefficient for the Method of Standard Additions was below 0.995

Organic Analyses

B - Compound was also detected in the laboratory method blank
D - Compound was quantified from a secondary dilution
E - Sample concentration is above the calibration range
J - Result is below the reporting limit or estimated
I - Unknown and unquantifiable petroleum hydrocarbons present

APPENDIX E

SITE IR-1/21 BORELOGS

Log of Boring: IR01MW09B
Equipment: SIMCO 5,000 (ARCH), 10 in. diam.
Date: 01/17/1992
Elevation: GS 10.63 feet
Total Depth: 42.5 ft.

CHRISTY BOX

BOREHOLE
10 IN. DIAMETER

GROUT
Portland Type I-II
0.0 - 28.0 ft.

BLANK CASING
4 IN. DIAMETER
0.5 - 30.0 ft.

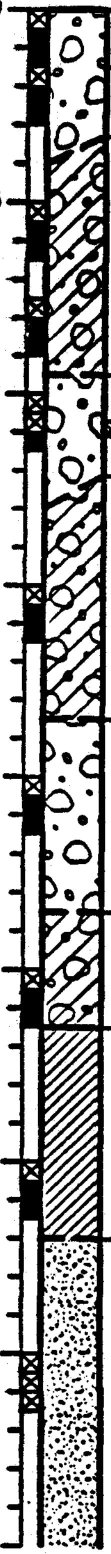
BENTONITE SEAL
Pellets
28.0 - 30.0 ft.

SANDPACK
RMC Lonestar #2/16
30.0 - 42.5 ft.

SLOTTED SCREEN
Schedule 40 PVC
(0.02 IN. SLOTSIZE)
32.0 - 42.0 ft.

Blows / 6"	OVA (ppm)	Sample Number
9, 8, 8	0	9203H067
3, 5, 4	0	9203H068
6, 8, 10	0	9203H069
10, 10, 8	0	9203H070
6, 10, 8	1	9203H071
2, 1, 18	0	9203H072
2, 5, 6	1	9203H073
2, 2, 7	10	9203H074
2, 2, 7	8	9203H075
1, 1, 4	6	

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 35, 40



VERY DARK GRAYISH BROWN WELL-GRADED GRAVEL WITH SAND (GW)
2.5Y3/2, medium dense, moist,
60-80% subangular to subrounded gravel,
20-40% fine- to coarse-grained sand, fill

Trace greenish gray (5GY4/1) clay by 1.5 ft.

DARK GREENISH GRAY CLAYEY GRAVEL WITH SAND (GC)
5GY4/1, medium dense, moist,
60% serpentinite gravel, 20-30% fine-grained sand, 10-20% lean clay, fill

VERY DARK GRAY WELL-GRADED GRAVEL (GW)
N3/0, loose, moist to wet,
angular gravel, some free oil product, fill

DARK GREENISH GRAY CLAYEY GRAVEL WITH SAND (GC)
5GY4/1, medium dense, wet,
50-60% well-graded serpentinite gravel,
20-30% fine-grained sand, 20% lean clay,
fill

DARK GREENISH GRAY WELL-GRADED GRAVEL WITH SAND (GW)
5GY4/1, loose, wet,
70% angular serpentinite gravel, 30% fine- to medium-grained sand, fill

VERY DARK GRAYISH BROWN CLAYEY GRAVEL WITH SAND (GC)
2.5Y3/2, medium dense, moist to wet,
50% well-graded gravel, 30% clay,
20% fine-grained sand, fill

DARK GREENISH GRAY FAT CLAY (CH)
5GY4/1, medium stiff, moist,
mostly clay, 5% silt, trace to few shell fragments, Bay Mud Deposits

DARK GREENISH GRAY POORLY GRADED SAND (SP)
5G4/1, medium dense, wet,
fine-grained sand, trace to 5% lean clay,
Undifferentiated Sedimentary Deposits

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring IR01MW09B with Well Completion Detail

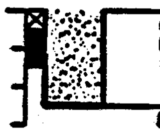
PLATE

HUNTER'S POINT ANNEX
SAN FRANCISCO, CA

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MF			11/09/92	

Log of Boring: IR01MW09B (p. 2)
Equipment: SIMCO 5,000 (ARCH), 10 in. diam.
Date: 01/17/1992
Elevation: GS 10.63 feet
Total Depth: 42.5 ft.

Blows / 6"	OVA(ppm)	Sample Number	Depth (ft)	Sample
15			40	
32				
45	2	9203H076		



Color change to light olive brown (2.5Y5/4) by 40 ft., loose to dense, moist to wet

Bottom of boring at 42.5 feet.

Harding Lawson Associates
Engineering and Environmental Services

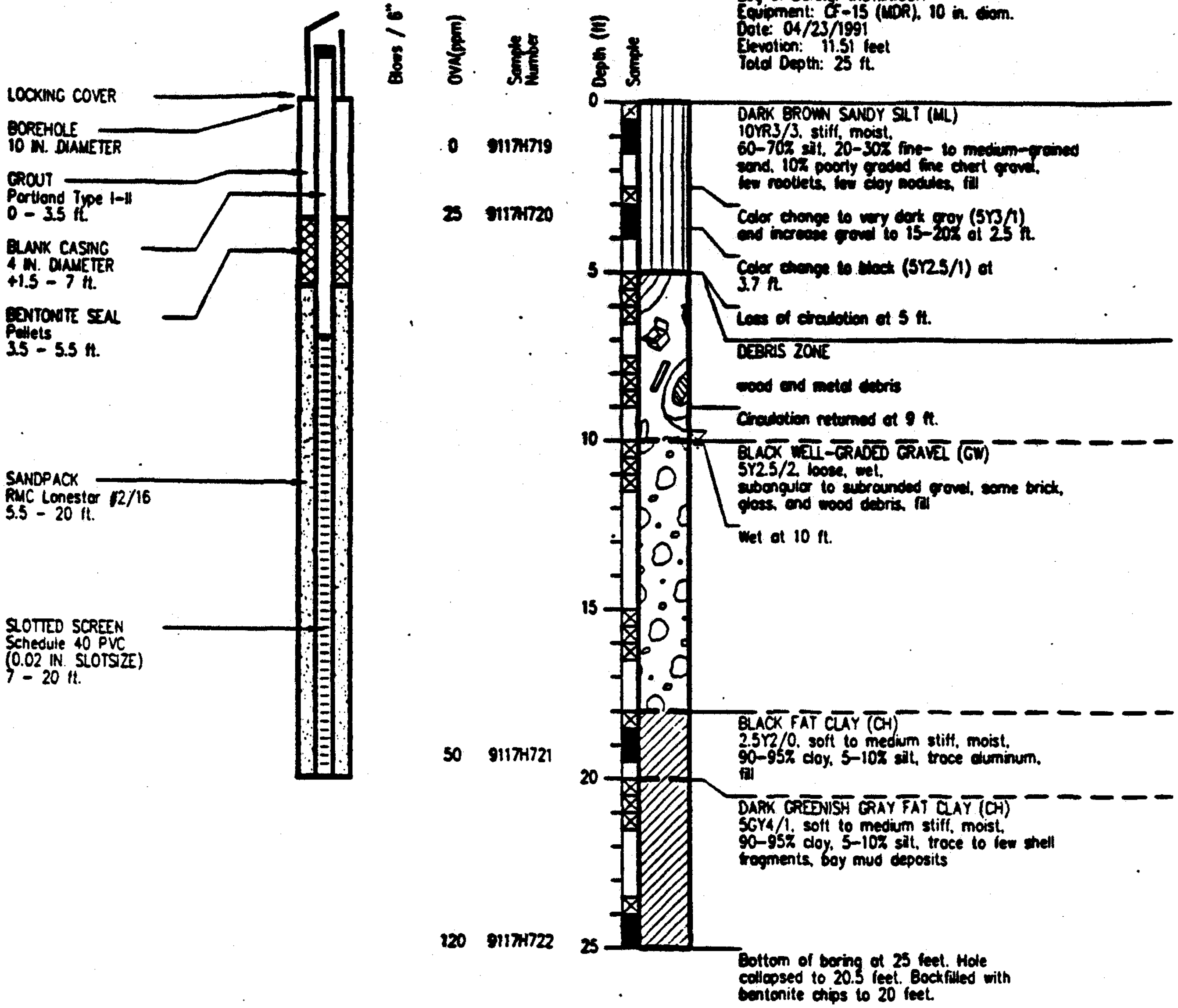
Log of Boring IR01MW09B with Well Completion Detail

HUNTER'S POINT ANNEX
SAN FRANCISCO, CA

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
MF			11/09/92	

Log of Boring: IR01MW38A
Equipment: CF-15 (MDR), 10 in. diam.
Date: 04/23/1991
Elevation: 11.51 feet
Total Depth: 25 ft.



Harding Lawson Associates
Engineering and Environmental Services

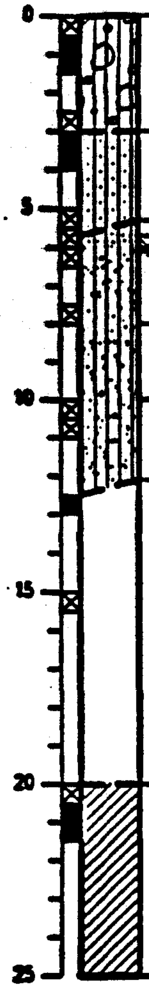
Log of Boring IR01MW38A with Well Completion Detail
Naval Station Treasure Island
Hunters Point Annex
San Francisco, California

PLATE

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
			1/94	

Log of Boring: IR01B039
Equipment: CME 750 (HSA), 8.0 in. diam.
Date: 11/05/1990
Elevation: GS 8.08 feet
Total Depth: 25.0 ft.

Blows / 6"	OVA (ppm)	Sample Number
7 23 25	2	9045P035
23 50 50	2	9045P036
6 8 3	0	
50		
8 50		
50	8	9045P037
50		
3 3 3		9045P038



YELLOWISH BROWN SILTY GRAVEL WITH SAND (GM)
10YR5/4, loose, dry,
50-60% gravel, 10-20% fine to medium-grained sand, 20-30% silt, fill

DARK OLIVE GRAY WELL-GRADED SAND WITH SILT (SW-SM)
10YR3/2, dense, dry,
80% fine to medium-grained sand, 10% silt,
10% medium to coarse gravel, fill

VERY DARK GRAY SILTY SAND (SM)
2.5Y3/0, loose, wet,
70-80% fine-grained sand, 20-30% silt,
0-10% gravel, fill

Coils of copper wire

Wood chips and copper wire

BLACK DEBRIS FILL
5Y2/1, wet,
50% wood fragments, 0-5% copper wire

DARK OLIVE GRAY FAT CLAY (CH)
5Y3/2, soft, wet,
95-100% clay

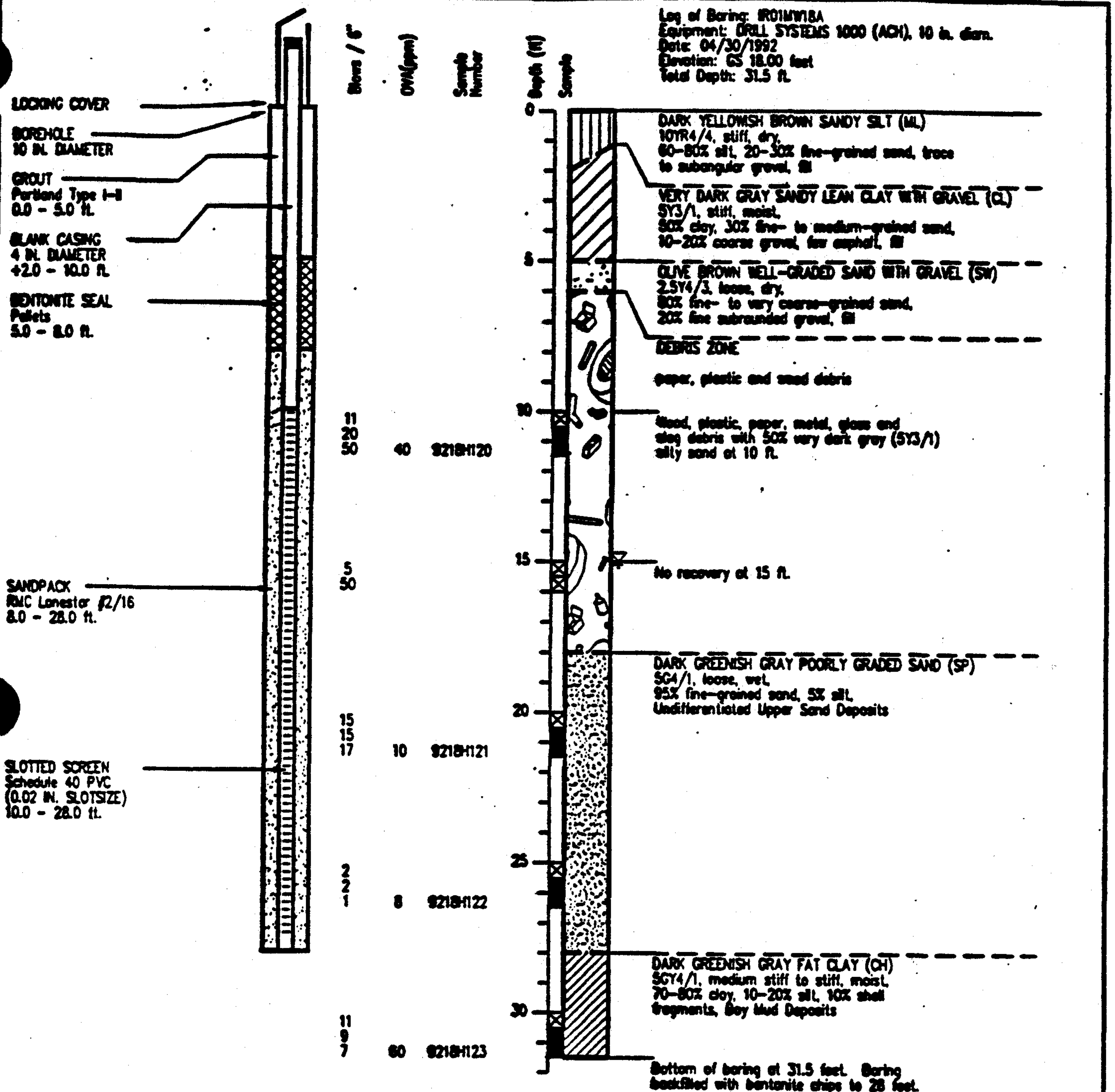
Bottom of boring at 25 ft., 10 ft. of auger lost at bottom of the boring. Drilled back down to 15 ft. and tremied cement into lost augers. 150 gallons of bentonite cement grout used to backfill boring.

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring: IR01B039
Primary Phase Remedial Investigation
Naval Station, Treasure Island, Hunters Point Annex
San Francisco, California

A6

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
GDT	18639.160.02		10/91	

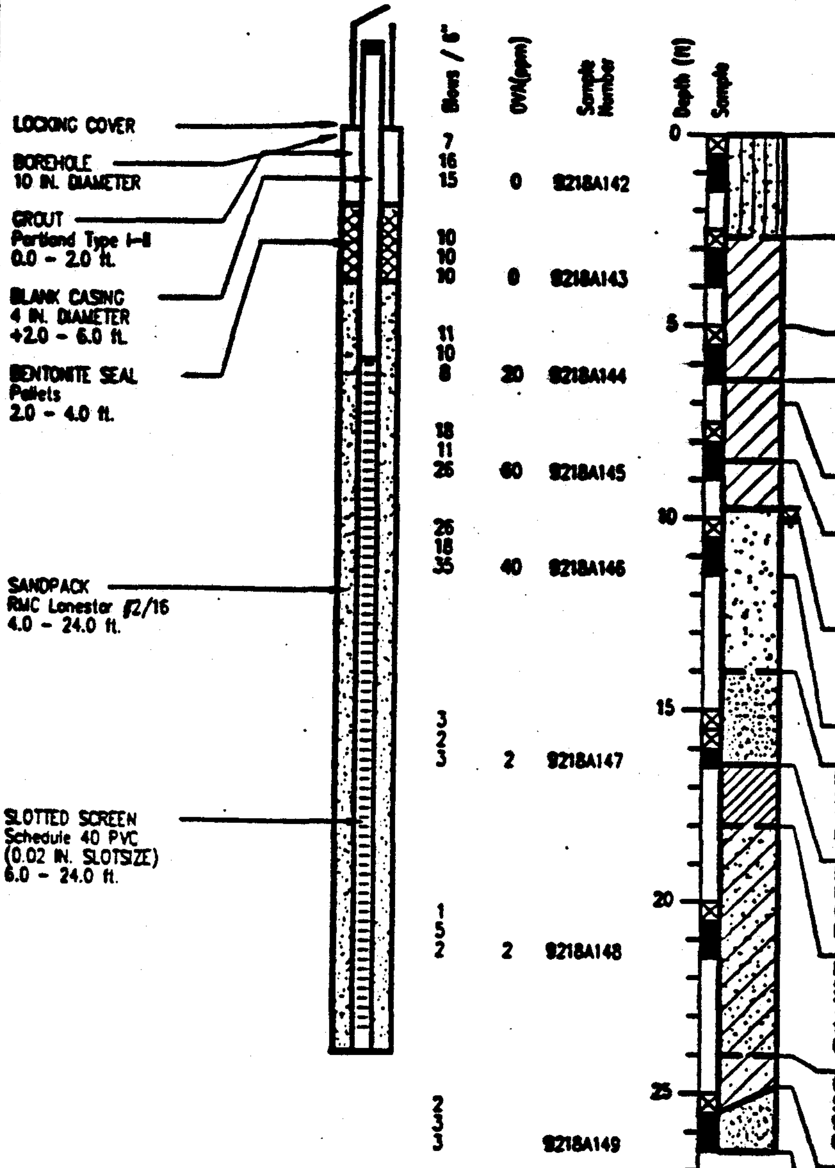


Harding Lawson Associates
Engineering and Environmental Services

Log of Boring IR01MW18A with Well Completion Detail

Naval Station, Treasure Island
Hunters Point Annex
San Francisco, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
WJF			10/92	



Log of Boring: IR01MW31A
Equipment: DRILL SYSTEMS 1000 (ACH), 10 in. diam.
Date: 05/01/1992
Elevation: GS 11.60 feet
Total Depth: 26.5 ft.

YELLOWISH BROWN SILTY SAND WITH GRAVEL (SM)
10YR5/4, loose, dry,
50% medium- to coarse-grained sand,
25% silt, 25% angular gravel, fill

DARK YELLOWISH BROWN SANDY LEAN CLAY WITH GRAVEL (CL)
10YR4/4, soft, moist,
50% clay, 35% fine-grained sand,
15% subangular gravel, fill

Wood and brick debris at 5 ft.

BLACK GRAVELLY LEAN CLAY (CL)
N2/0, soft, moist,
50% clay, 35% subangular gravel,
15% wood and paper, fill

Serpentinite gravel and wood debris at 7 ft.

DARK GRAY SANDY LEAN CLAY (CL)
medium stiff, moist,
40% clay, 20% medium-grained sand,
40% asphalt, fill

GRAYISH BROWN WELL-GRADED SAND WITH GRAVEL (SW)
10YR5/2, dense, wet,
65% fine-grained sand, 35% angular gravel,
fill

70% gravel debris at 11.5 ft.

DARK GRAY POORLY GRADED SAND (SP)
5Y4/1, loose, wet,
100% medium-grained sand,
Undifferentiated Upper Sand Deposits

BLACK FAT CLAY (CH)
N2/0,
60% organic clay, 40% silt,
Bay Mud Deposits

DARK GRAY CLAYEY SAND (SC)
5Y4/1, loose, wet,
75-85% medium-grained sand, 15% lean clay,
trace to few shell fragments,
Undifferentiated Upper Sand Deposits

OLIVE POORLY GRADED SAND WITH CLAY (SP-SC)
5Y5/3, loose, wet,
90% fine-grained sand, 10% clay,
Undifferentiated Sedimentary Deposits

OLIVE POORLY GRADED SAND (SP)
5Y5/3, loose, wet,
fine-grained sand,
Undifferentiated Sedimentary Deposits

Bottom of boring at 26.5 feet. Boring backfilled with bentonite chips to 24 feet.

Harding Lawson Associates
Engineering and Environmental Services

Log of Boring IR01MW31A with Well Completion Detail

Naval Station, Treasure Island
Hunters Point Annex
San Francisco, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
WJF			10/92	

PLATE

Log of Boring: IR01MW03A
Equipment: CF-15 (MDR), 10 in. diam.
Date: 04/24/1991
Elevation: GS 19.36 feet
Total Depth: 31.5 ft.

LOCKING COVER

BOREHOLE
10 IN. DIAMETER

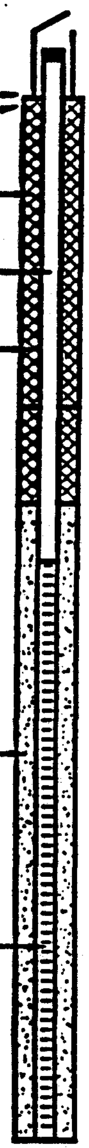
GROUT
Portland type I-II
0 - 8 ft.

BLANK CASING
4.00 IN. DIAMETER
+1 - 12 ft.

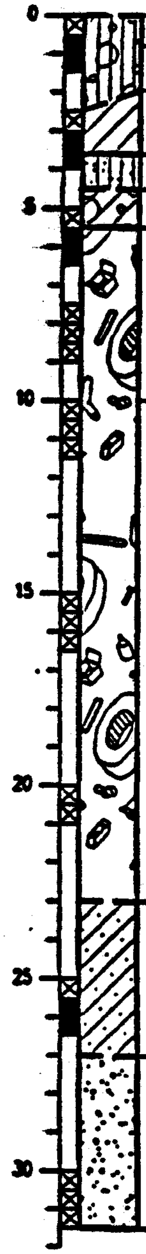
BENTONITE SEAL
Pellets
8 - 10.5 ft.

SANDPACK
RMC Lonestar #2/16
10.5 - 27 ft.

SLOTTED SCREEN
Schedule 40 PVC
(0.02 IN. SLOTSIZE)
12 - 27 ft.



Blows / 6"	ova(ppm)	Sample Number
	0	9117H723
	10	9117H724
	75	9117H725
	70	9117H726



GRAYISH GREEN SILTY GRAVEL WITH SAND (GM)
5G5/2, medium dense, moist,
50-60% subrounded to subangular serpentinite gravel, 20-30% well-graded fine- to coarse-grained serpentinite sand, 20% silt, fill

Color change to dark reddish brown (5YR3/2) at 0.8 ft.

DARK YELLOWISH BROWN GRAVELLY LEAN CLAY WITH SAND (CL)
10YR3/4, medium stiff, moist,
50-60% clay, 20-30% well-graded gravel, 10-20% silt, fill

VERY DARK GRAYISH BROWN SILTY SAND (SM)
2.5Y3/2, medium dense, moist,
75-80% poorly graded sand, 20% silt, 0-5% fine gravel, fill

DARK YELLOWISH BROWN CLAYEY GRAVEL (GC)
10YR3/4, medium dense, moist,
60-70% well-graded gravel, 20-30% clay, 10% fine-grained sand, fill

DEBRIS ZONE

Mostly wood, steel, brass, glass, plastic, asbestos, cloth, 20% well-graded sand and poorly graded gravel, fill

Loss of circulation at 10 ft.

DARK GREENISH GRAY POORLY GRADED SAND WITH CLAY (SP-SC)
5GY4/1, loose, wet,
90% fine- to medium-grained sand, 10% clay, little shell fragments, trace cloth debris (possible slough)

LIGHT OLIVE BROWN WELL-GRADED SAND (SW)
2.5Y5/4, dense to very dense, moist to dry,
95% sand, 5% silt

Bottom of boring at 31.5 feet, no circulation from 10 feet, to total depth. Boring backfilled from 31.5 to 27 feet with bentonite chips.

Harding Lawson Associates
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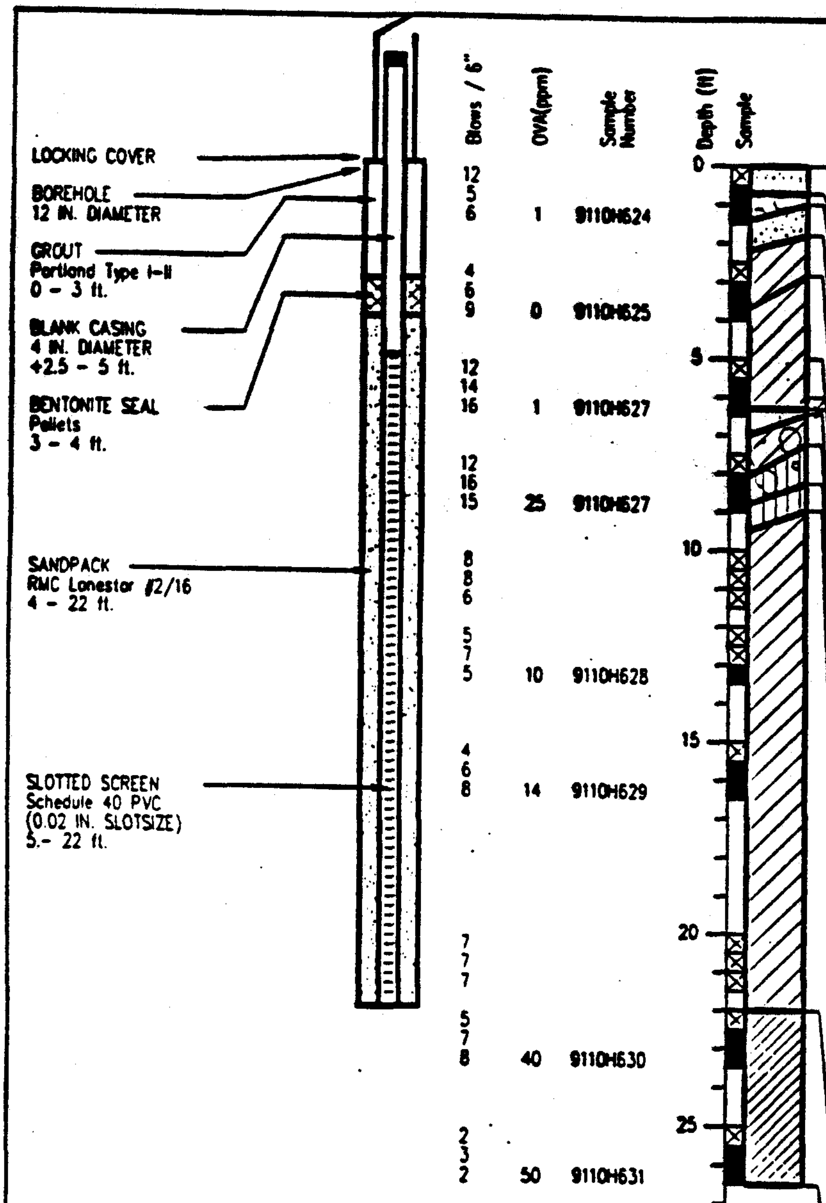
Log of Boring IR01MW03A with Well Completion Detail
Naval Station Treasure Island
Hunters Point Annex
San Francisco, California

PLATE

Log of Boring: IR01MW07A
Equipment: Mobile B-53 (HSA), 12 in. diam.
Date: 03/08/1990
Elevation: GS 16.71 feet
Total Depth: 26.5 ft.



VERY DARK GRAY POORLY GRADED SAND WITH GRAVEL (SP)
10YR3/1, loose to medium dense, moist,
70-80% medium-grained sand, 20-30% poorly graded predominantly fine rounded to subrounded gravel, few wood debris, fill

BLACK POORLY GRADED GRAVEL WITH SAND (GP)
10YR2/1, loose to medium dense, moist,
60% fine subrounded gravel, 40% medium-grained sand, fill

DARK YELLOWISH BROWN POORLY GRADED SAND WITH GRAVEL (SP), 10YR3/6, loose, moist,
70-90% medium-grained sand, 10-30% poorly graded fine to medium subrounded gravel, fill

DARK BROWN SANDY LEAN CLAY WITH GRAVEL (CL)
7.5YR3/4, soft, moist,
50% clay, 30% medium-grained sand, 20% poorly graded subangular to subrounded chert gravel, fill

DARK BROWN SANDY LEAN CLAY (CL)
7.5YR3/4, soft to medium stiff, moist,
60-80% clay, 20-40% fine- to medium-grained sand, fill

Interbedding of black well-graded sand and fine rounded gravel at 5 ft.

DARK GRAYISH BROWN WELL-GRADED GRAVEL WITH SAND (GW)
2.5Y4/2, loose to medium dense, wet,
80-90% subangular to subrounded gravel,
10-20% fine- to medium-grained sand, fill

DARK REDDISH BROWN CLAYEY GRAVEL (GC)
10YR3/3, medium dense, moist to wet,
70-80% well-graded subangular to subrounded chert gravel, 20-30% clay, trace sand, fill

DARK GREENISH GRAY SILTY GRAVEL WITH SAND (GM)
5GY4/1, medium dense, moist,
60-80% well-graded serpentinite gravel,
10-20% silt, 10-20% fine- to medium-grained sand, fill

DARK GREENISH GRAY GRAVELLY SILT (ML)
5G4/1, medium stiff, moist,
70 silt, 10-20% fine poorly graded subrounded serpentinite gravel, 10-20% fine- to medium-grained sand, fill

DARK REDDISH GRAY SANDY LEAN CLAY WITH GRAVEL (CL)
5YR4/2, soft, moist to wet,
40-60% clay, 30-40% fine- to medium-grained sand, 10-30% poorly graded gravel, fill

DARK GREENISH GRAY FAT CLAY (CH)
5GY4/1, soft, moist,
90-95% clay, 5-10% silt, few shell fragments, bay mud deposits

Bottom of boring at 26.5 feet. Boring backfilled with bentonite chips from 22 to 26.5 feet.

Harding Lawson Associates
Engineering and Environmental Services

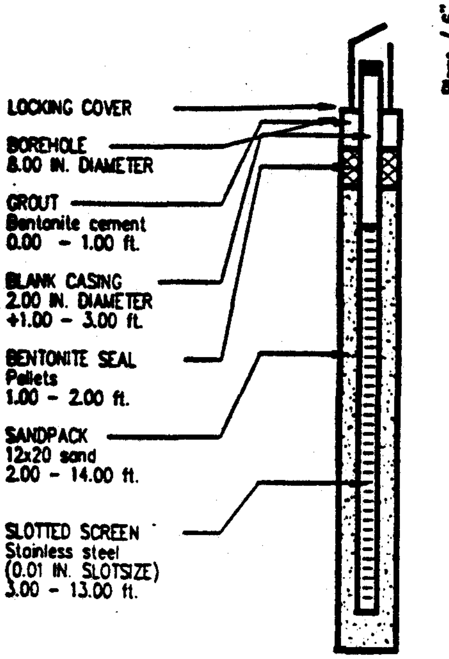
Log of Boring IR01MW07A with Well Completion Detail

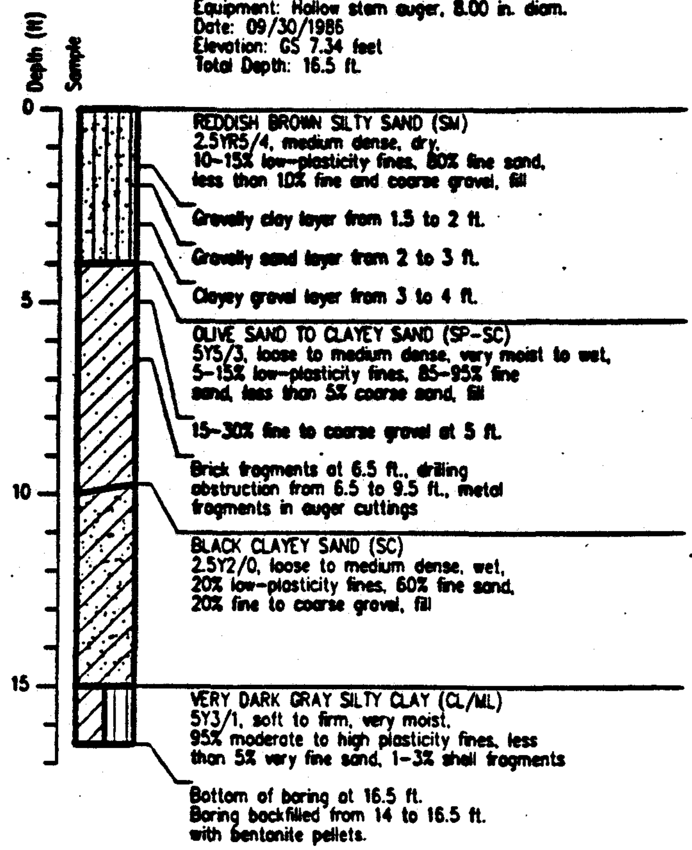
Naval Station, Treasure Island
Hunters Point Annex
San Francisco, California

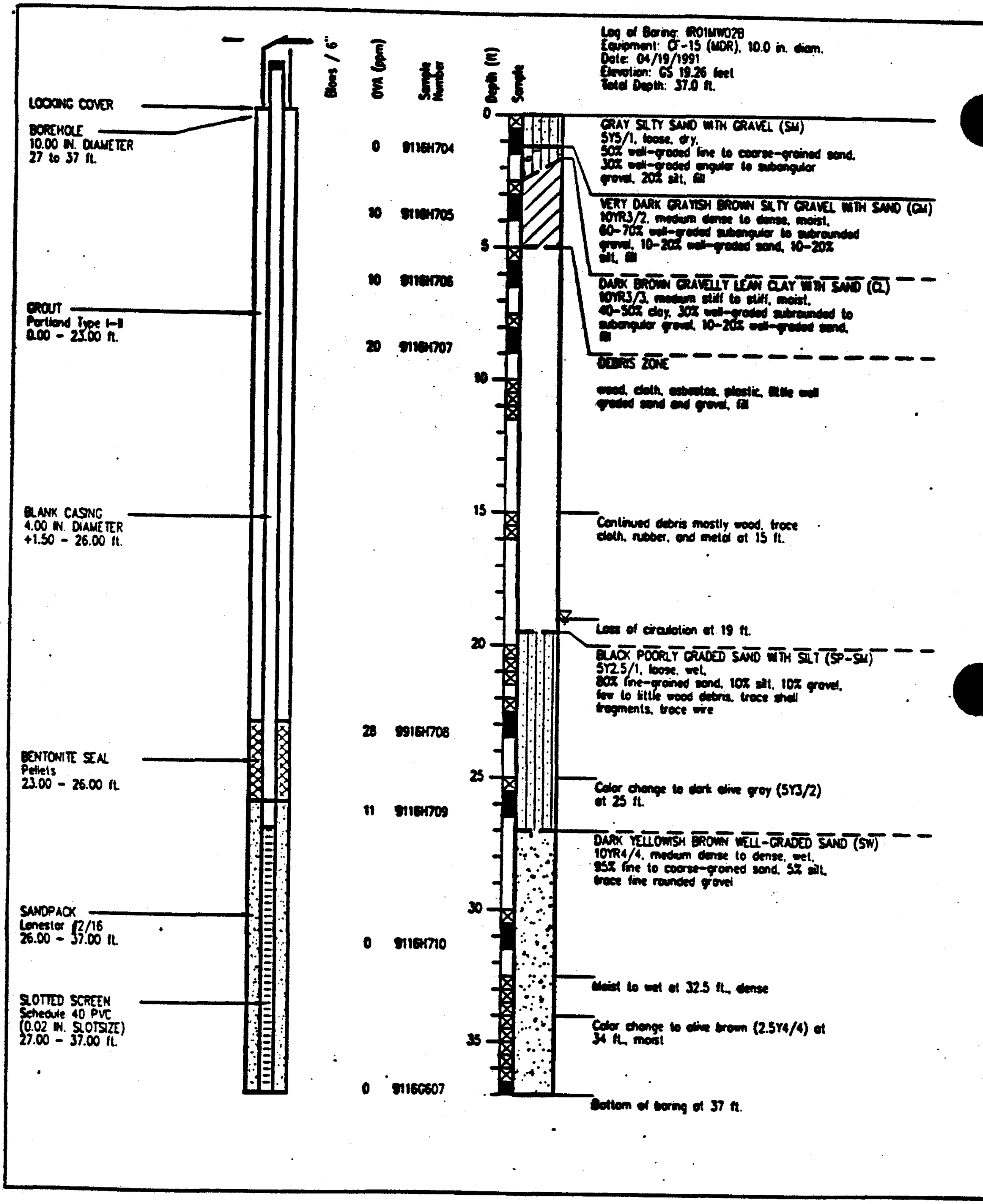
PLATE

DRAWN | JOB NUMBER | APPROVED | DATE 11/93 | REVISED DATE

Log of Boring: IR01MW-9
Equipment: Hollow stem auger, 8.00 in. diam.
Date: 09/30/1986
Elevation: GS 7.34 feet
Total Depth: 16.5 ft.







Harding Lawson Associates
Engineering and Environmental Services

Log of Boring and Well Completion Detail: IR01MW02B
Primary Phase Remedial Investigation
Naval Station, Treasure Island, Hunters Point Annex
San Francisco, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CMM	18639,110.02		4/92	

LOG OF EXPLORATORY BORING

PROJECT NUMBER 365-02.02

PROJECT NAME HPNS-Industrial Landfill Area

BY SK DATE 9/16/86

BORING NO. I07

SURFACE ELEV. * 109.52'

PHOTO-VAC (ppm)	POCKET PENETRO-METER (TSF)	PENETRATION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-GRAPHIC COLUMN	DESCRIPTION
		27	v,s m m		1	SP-SW	SAND-FILL; light yellowish brown (2.5Y, 6/4); <5% low-plasticity fines; >90% fine sand; <5% refuse: wood; loose to medium dense; damp to moist.
		6	▽ ▼ v,s		2	CL	SILTY CLAY; very dark gray (5Y, 3/1); >95% low- to moderate-plasticity fines <5% very fine sand; 1-2% shell fragments; soft; very moist.
		8	v,s m	5	3		
		2			4		
		2			5		
		2			6		
		2		10	7		
							BOTTOM OF BORING AT 13 FEET.
				15			
				20			

REMARKS

Drilled with 8-inch hollow-stem auger; sampled with 2-inch I.D. California modified split-spoon sampler fitted with stainless steel liners. Boring was converted to a 2-inch ground-water monitoring well as detailed on Plate 25. *Casing elevation is relative to Navy Datum.

LOG OF EXPLORATORY BORING

PROJECT NUMBER 365-02.02
PROJECT NAME HPNS-Industrial Landfill Area
BY SK DATE 9/16/86

BORING NO. I08
PAGE 1 OF 1
SURFACE ELEV. * 108.34'

PHOTO-VAC (ppm)	POCKET PENETRO-METER (TSF)	PENETRA-TION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-GRAPHIC COLUMN	DESCRIPTION
		17	▽ v,s m		1	GW-GC	SANDY GRAVEL TO CLAYEY GRAVEL-FILL; light brownish gray (5Y, 6/2); 5-10% low-plasticity fines; 30% fine to coarse sand; 60% fine and coarse gravel; 1-2% brick fragments; medium dense; very moist to wet.
		32	▽ m v,s		2		
		57	v,s m	5	3		@5': black (2.5Y, 2/0); trace wood.
		41			4		
		18			5		
		15			6		
		18		10	7		
							BOTTOM OF BORING AT 12.5 FEET.
				15			
				20			

REMARKS
Drilled with 8-inch hollow-stem auger; sampled with 2-inch I.D. California modified split-spoon sampler fitted with stainless steel liners. Boring was converted to a 2-inch ground-water monitoring well as detailed on Plate 27. *Casing elevation is relative to Navy datum.

LOG OF EXPLORATORY BORING

PROJECT NUMBER 365-02.02
PROJECT NAME HPNS-Industrial Landfill Area
BY SK DATE 9/11/86

BORING NO. I03
PAGE 1 OF 1
SURFACE ELEV. *113.51'

PHOTO-VAC (ppm)	POCKET PENETRO-METER (TSF)	PENETRA-TION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHO-GRAPHIC COLUMN	DESCRIPTION
		13		v,s	1	SW	GRAVELLY SAND-FILL; light olive brown (2.5Y, 5/4); <5% low-plasticity fines; 70% fine to coarse sand; 25-30% fine and coarse gravel; medium dense; dry. @ 2-2.5': metal fragments.
		20		m	2	SP	SAND-FILL; pale yellow (5Y, 7/3); <5% low-plasticity fines; 95% fine to medium sand; trace refuse: plastic, metal fragments; medium dense; dry to damp.
		17		5 m	3		@ 3.5-4': gray (7.5YR, 5/0).
		13	∇	v,s	4		@ 5-5.5': black cemented aggregate; very moist.
		19		v,s m	5		@6' wet.
		11			6		@8-9.5': dark yellowish brown (10YR, 4/6).
		13	▼	10	7		@ 10-10.5': black (2.5Y, 2/0).
		8			8		
		27			9		@12.5': 10-15% fine gravel.
		25		15	10		
		36			11		BOTTOM OF BORING AT 17 FEET.
				20			

REMARKS
Drilled with 8-inch hollow-stem auger; sampled with 2-inch I.D. California modified split-spoon sampler fitted with stainless steel liners. Boring was converted to a 2-inch ground-water monitoring well as detailed on Plate 16. *Casing elevation is relative to Navy datum.

LOG OF EXPLORATORY BORING

PROJECT NUMBER 365-02.02

BORING NO. Iø6

PROJECT NAME HPNS-Industrial Landfill Area

PAGE 1 OF 1

BY SK DATE 9/16/86

SURFACE ELEV. * 113.19

PHOTO-VAC (ppm)	POCKET PENETROMETER (TSF)	PENETRATION (Blows/Ft.)	GROUND WATER LEVELS	DEPTH IN FT.	SAMPLES	LITHOGRAPHIC COLUMN	DESCRIPTION
						GW	SANDY GRAVEL-FILL; reddish brown (2.5YR, 5/4); <5% low-plasticity fines; 35% fine to coarse sand; 55-60% coarse gravel; <5% brick fragments; medium dense; dry.
		30		v,s,m	1	SP	SAND-FILL; light gray (2.5Y, 7/2); <5% low-plasticity fines; >95% fine sand <5% brick fragments; loose; dry.
		31			2		@3.5': 1-2% cobble sized brick fragments.
		62	▽	v,s m 5 v,s	3		
			▼		4		@5.5': black (2.5Y, 2/0); 5% refuse: nails, aggregate; <5% fine gravel; very moist.
		50for 6"		m	5	GP	SANDY GRAVEL-FILL; very dark gray (5Y, 3/1); <5% low-plasticity fines; 25-30% fine to coarse sand; 55-70% fine gravel; medium dense; wet.
		50for 6"			6		@9': 10-15% cobbles.
		50for 6"		10	7		
							BOTTOM OF BORING AT 11.5 FEET.
				15			
				20			

REMARKS

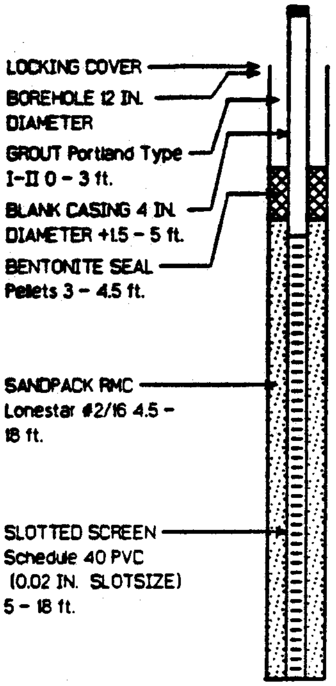
Drilled with 8-inch hollow-stem auger; sampled with 2-inch I.D. California modified split-spoon sampler fitted with stainless steel liners. Boring was converted to a 2-inch ground-water monitoring well as detailed on Plate 23. *Casing elevation is relative to Navy datum.

PRC Environmental Management, Inc.

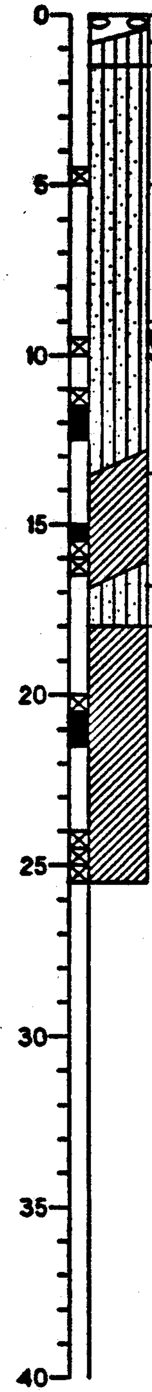
Adapted from Harding Lawson Associates

LOG OF BORING IR01MW48A

Well Diagram



Blows/6 in.	OVA (ppm)	Sample No.
	5	
	8	
2 2 3	11	9043H332
1 2 3		9043H333
1 1 1	5	9043H334
1 1 1	7	



Materials Description

GRAYISH BROWN SILTY GRAVEL WITH SAND (GM) 2.5Y5/2, very loose, dry, 40-60% fine to coarse gravel, 20-40% fine- to coarse-grained sand, 20% silt, fill

LIGHT GRAY SILT WITH SAND (ML) 2.5Y7/2, very loose, dry, 70-90% silt, 20% medium- to coarse-grained sand, 10% gravel, fill

VERY DARK BROWN SILTY SAND WITH GRAVEL (SM) 10YR2/2, medium dense, moist, 70-85% fine- to coarse-grained sand, 15% silt, 5-10% fine gravel with wood and cloth debris, fill

Color change to black, abundant wood debris from 5 to 10 ft.

25% chert gravel, trace nails at 9 ft.

Wet at 10 ft.

BLACK FAT CLAY WITH SAND (CH) 2.5Y2/0, very soft, wet, 80-90% clay, 20% sand, fill

SILTY SAND (SM) wet fluid unit

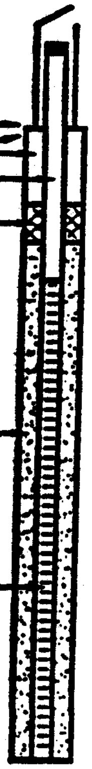
DARK GREENISH GRAY FAT CLAY (CH) 5BG4/1, med. stiff to stiff, moist, 90-100% clay, 10% silt, 15-20% shell fragments, bay mud deposits

Bottom of boring at 25.5 feet. Boring backfilled with bentonite chips from 18 to 25.5 feet.

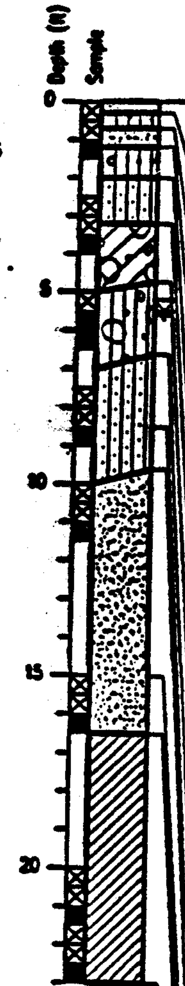
Project Number		Date Drilled	10/24/1990
Project Name	Naval Station, Treasure Island	GS Elevation	9.03
Project Task		Water Level	10 ft.
Project Location	San Francisco, California	Total Depth Of Hole	25.5 ft.
Equipment	CME 750 (HSA) 12 in. diam.		

Figure

Log of Boring: IR01MW58A
Equipment: MOBILE B-53 (HSA), 12.0 in. diam.
Date: 03/07/1991
Elevation: GS 6.83 feet
Total Depth: 23.0 ft.



Blows / 6"	OVA (ppm)	Sample Number
6 18 37	0	9110H616
6 8 10	0	9110H617
4 6 13	110	9110H618
12 6 4	120	9110H619
9 11 15	75	9110H620
14 9 4		9110H621
2 3 3		9110H622
2 3 4		9110H623



DARK BROWN POORLY GRADED SAND (SP)
7.5YR3/4, loose, wet,
100% medium-grained sand, trace rootlets,
fill

DARK REDDISH BROWN SILTY GRAVEL (GM)
5YR3/3, medium dense, moist,
70% well-graded angular to subrounded chert
gravel, 30% silt, fill

DARK YELLOWISH BROWN POORLY GRADED SAND (SP)
10YR3/4, very loose, wet,
100% medium-grained sand, trace rootlets,
fill

GREENISH GRAY SILTY GRAVEL (GM)
5GY5/1, medium dense, dry,
70-80% well-graded serpentinite gravel,
20-30% silt, fill

DARK REDDISH BROWN POORLY GRADED SAND WITH SILT AND GRAVEL (SP-SM), loose to medium dense, moist to wet,
60-70% medium-grained sand, 30% subangular
to subrounded chert gravel, 10% silt, fill

BLACK CLAYEY GRAVEL (GC)
5Y2.5/1, medium dense, moist,
70-80% well-graded predominantly very coarse
gravel, 20-30% lean clay, trace wood and
brick debris, fill

BLACK SILTY GRAVEL WITH SAND (GM)
2.5YR2.5/0, medium dense, wet,
50-70% well-graded subrounded to subangular
gravel, 20% elastic silt, 10-30% poorly
graded medium-grained sand, trace insulated
wire and wood, fill

BLACK POORLY GRADED SAND WITH SILT AND GRAVEL
(SP-SM), 2.5YR2.5/0, very loose, wet,
70% medium-grained sand, 10% silt, 20%
poorly graded fine gravel, fill

15-25% copper wire with a black rubber
insulation, 0-5% ceramic tile from 7-10 ft.

BLACK POORLY GRADED SAND WITH GRAVEL (SP)
2.5YR2.5/0, loose, wet,
60-70% medium-grained sand, 30-40% poorly
graded subangular gravel, trace silt, some
copper wire, fill

Decreasing gravel to 20-30%, increasing
sand to 70-80%, continued wire and ceramic
tile debris

DARK GREENISH GRAY FAT CLAY (CH)
5GY4/1, medium stiff, moist,
95-100% clay, 0-5% silt, few shell
fragments, Bay Mud deposits

Bottom of boring at 23 ft.
Boring backfilled from 23 to 16.5 ft. with
bentonite chips

Harding Lawson Associates
Engineering and
Environmental Services

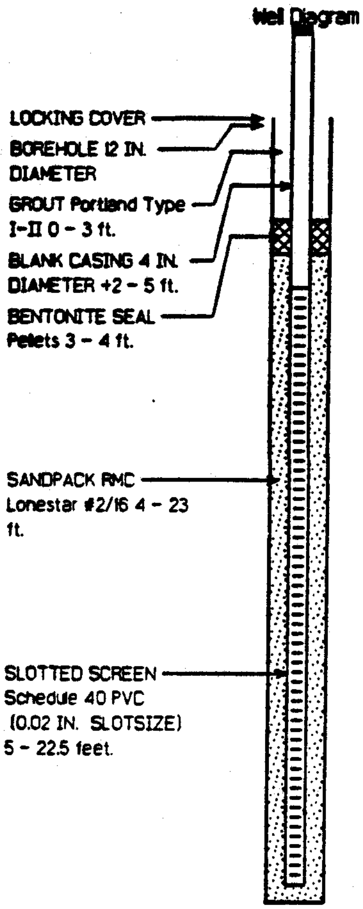
Log of Boring and Well Completion Detail: IR01MW58A
Primary Phase Remedial Investigation
Naval Station, Treasure Island, Hunters Point Annex
San Francisco, California

DRAWN	JOB NUMBER	APPROVED	DATE	REVISED DATE
CMM	18639.160.02		4/92	

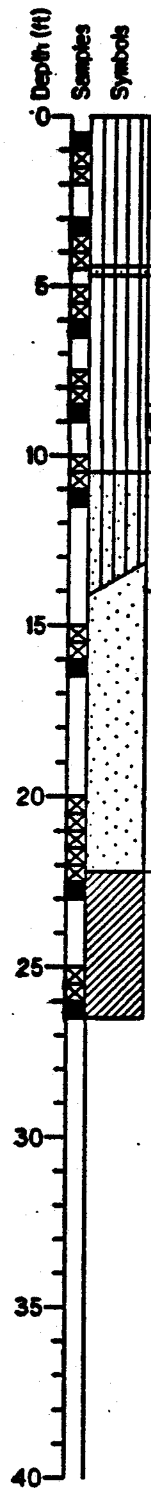
PLATE

***PRC* Environmental Management, Inc.**
Adapted from Harding Lawson Associates

LOG OF BORING IR01MW43A



Blows/6 in.	OVA (ppm)	Sample No.
13, 17, 21	0	9110F091
4, 5, 20	0	9110F092
18, 22, 50	0	9110F093
3, 4, 6	40	9110F094
21, 30, 15	15	9110F095
7, 11, 10	100	9110F096
6, 9, 8, 10, 8, 5	30	9110F097
3, 2, 3	30	9110F098



Materials Description

VERY DARK GRAYISH BROWN SILT WITH GRAVEL (ML) 2.5Y3/2, medium stiff to stiff, moist, 80% silt, 15% fine angular gravel, 5% fine- grained sand, wood debris, fill

Pieces of asphalt at 3 ft.

DARK BROWN POORLY GRADED SAND WITH SILT (SP-SM) 10YR3/3, loose, moist, 90% medium-grained sand, 10% silt, fill

VERY DARK GRAYISH BROWN SANDY SILT (ML) 10YR3/2, stiff, moist to wet, 70% silt, 20% fine- to medium-grained sand, 10% fine to medium angular gravel, trace cloth and fiberous material, fill

Color change to black (2.5YN/2) at 8.5 ft., with wire debris

BLACK SILTY SAND (SM) 2.5Y2/0, medium dense, wet, 85% very fine- to fine-grained sand, 15% silt, sheen on sampler, fill

VERY DARK GRAYISH BROWN WELL-GRADED SAND (SW) 2.5Y3/2, loose, wet, very fine- to medium-grained sand, trace silt, possible paint chips, wire, fill

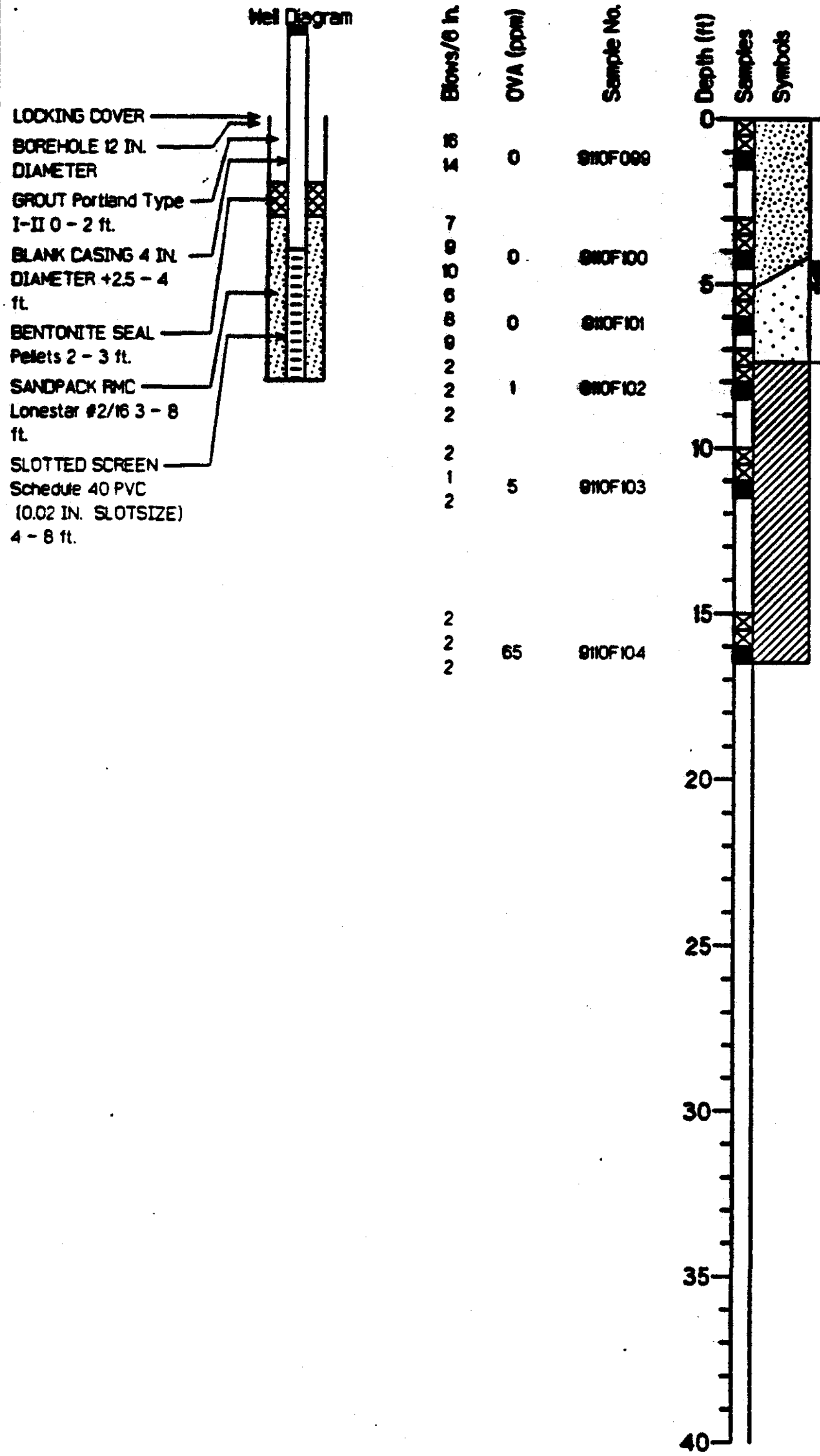
DARK OLIVE GRAY FAT CLAY (CH) 5Y3/2, soft, moist, 97% clay, trace shell fragments, bay mud deposits

Bottom of boring at 26.5 feet. Boring backfilled with bentonite chips from 23 to 26.5 feet.

Project Number		Date Drilled	03/06/1991
Project Name	Naval Station, Treasure Island	GS Elevation	10.17
Project Task		Water Level	9.5 ft.
Project Location	San Francisco, California	Total Depth Of Hole	26.5 ft.
Equipment	MOBILE B-53 (HSA) 12 in. diam.	Figure	

PRC Environmental Management, Inc.
Adapted from Harding Lawson Associates

LOG OF BORING IR01MW44A



Blows/6 in.	OVA (ppm)	Sample No.
16, 14	0	9110F099
7, 9, 10	0	9110F100
6, 8, 9	0	9110F101
2, 2, 2	1	9110F102
2, 1, 2	5	9110F103
2, 2, 2	65	9110F104

Materials Description

BLACK POORLY GRADED SAND (SP) 2.5Y2/0, loose, moist to wet, fine- to medium-grained sand, possible sandblast material, fill

Color change to olive brown (2.5Y4/4) at 3.75 ft.

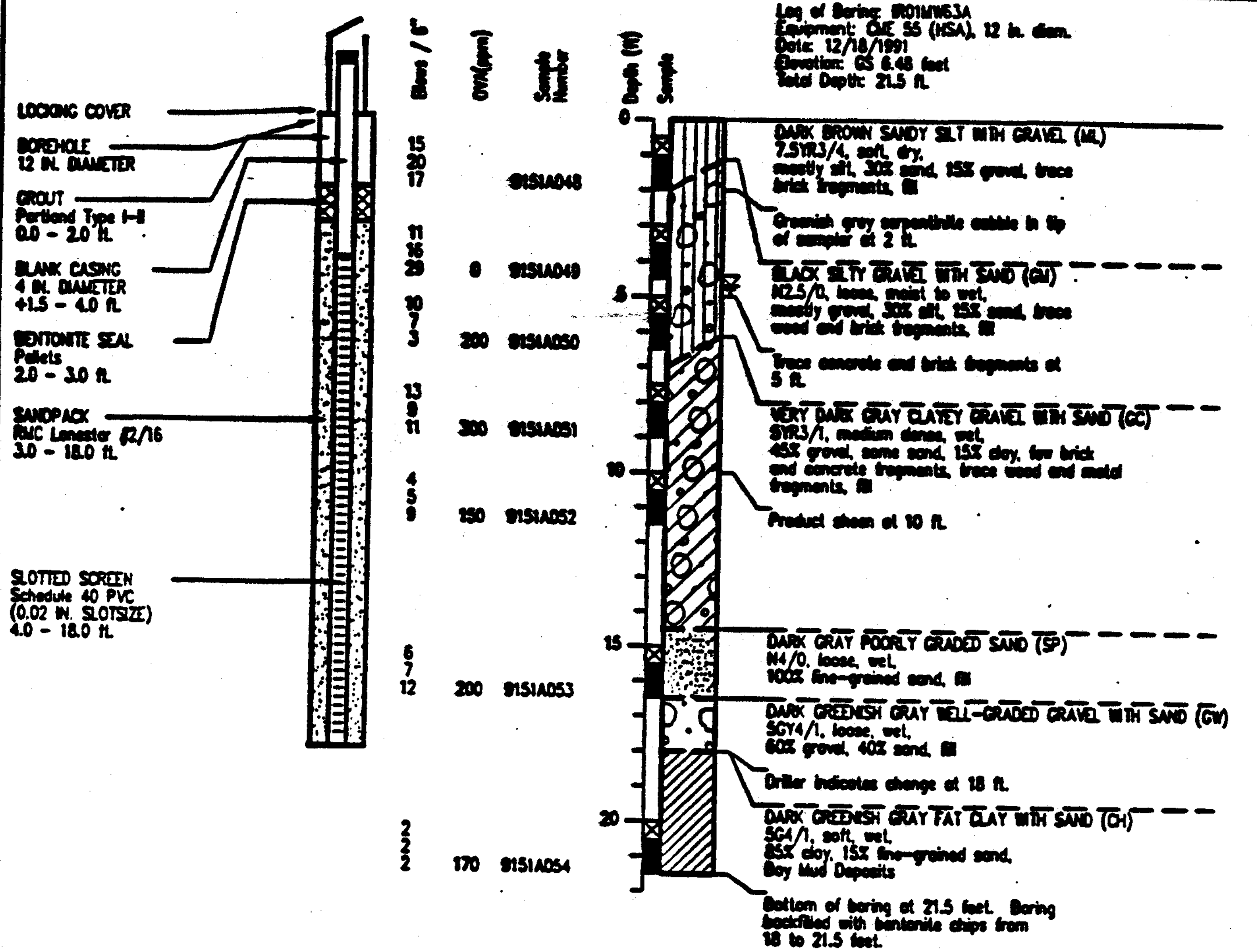
BLACK WELL-GRADED SAND (SW) 2.5Y2/0, loose, wet, fine- to coarse-grained sand, wood debris, possible sandblast material, fill

DARK GREENISH GRAY FAT CLAY (CH) 5GY4/1, soft, moist, trace shell fragments, bay mud deposits

Bottom of boring at 16.5 feet. Boring backfilled with bentonite chips to 8 feet.

Project Number		Date Drilled	03/06/1991
Project Name	Naval Station, Treasure Island	GS Elevation	6.59
Project Task		Water Level	5 ft.
Project Location	San Francisco, California	Total Depth Of Hole	16.5 ft.
Equipment	MOBILE B-53 (HSA) 12 in. diam.		

Figure



Harding Lawson Associates
Engineering and Environmental Services

Log of Boring IR01MW63A with Well Completion Detail

Naval Station, Treasure Island
Hunters Point Annex
San Francisco, California

PLATE

DRAWN VF | JOB NUMBER | APPROVED | DATE | REVISED DATE

PRC Environmental Management, Inc.
Adapted from Harding Lawson Associates

LOG OF BORING IR01B275

Blows/6 in.	OVA (ppm)	Sample No.	Depth (ft)
18			0
18		9226A322	
8			
17	10	9226A373	
21			
6			5
17	30	9226A374	
20			
10			
15	30	9226A375	
25			
21			10
19	8	9226A376	
23			
13			15
11			
11			
17			20
23			
19			
23			25
4			
5			
6	4	9226A378	
2			
2			
			30
			35
			40

Materials Description

LIGHT REDDISH BROWN GRAVELLY LEAN CLAY (CL) 5YR6/6, medium stiff, dry, 60% clay, 30% subangular gravel, 10% medium- to fine-grained sand, fill

VERY DARK GRAY SANDY LEAN CLAY (CL) 5YR3/1, soft, dry, 65% clay, 35% medium- to fine-grained sand, 10% gravel, trace wood, plastic and nails, fill

50% wood debris by 5 ft.

DEBRIS ZONE wood, cloth, plastic

GRAY POORLY GRADED SAND WITH GRAVEL (SP) 5Y6/1, loose, wet, 65% coarse-grained sand, 35% subrounded gravel, fill

DEBRIS ZONE wood

No recovery at 15 ft.

No recovery at 20 ft., black oily odor logged from cutting

DARK GREENISH GRAY FAT CLAY (CH) 5GY4/1, soft, wet, 75% clay, 20% shell fragments, 5% fine-grained sand, Bay Mud Deposits

Bottom of boring at 28 feet. Boring backfilled with bentonite cement grout (6/26/92). Grab water sample 9226A377 collected.

Project Number	
Project Name	Naval Station, Treasure Island
Project Task	
Project Location	San Francisco, California
Equipment	DRILL SYSTEMS 1000 (ACH) 10 in. diam.
Date Drilled	06/26/1992
GS Elevation	12.49
Water Level	11.0 ft.
Total Depth Of Hole	28 ft.

Figure

APPENDIX F

COST OPINION DETAILS

ALTERNATIVE 2: SHEET PILE CONTAINMENT, GROUNDWATER EXTRACTION WITH WELL POINTS SANITARY SEWER DISCHARGE

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COST ANALYSIS

Item/Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
CONSTRUCTION COSTS				
Equipment				
Mobilization/Demobilization	1	lump	$5,000.00	$5,000
Sheet Piling	9,000	square feet	$0.45	$4,100
Well Point System				
Well Points	1	each	$2,000.00	$2,000
Riser Pipe	300	vertical feet	$0.00	$0
4" Header	600	linear feet	$0.10	$100
Valves	45	each	$1.96	$100
Fittings	45	each	$1.50	$100
Pumps	2	each	$0.00	$0
Transfer Pump	1	each	$4.30	$0
Transfer Piping	900	linear feet	$0.10	$100
Transfer Fittings	90	each	$1.50	$100
			Subtotal	$11,600
Labor				
Sheet Piling	9,000	square feet	$1.00	$9,000
Well Point System				
Well Points	30	each	$41.67	$1,300
Riser Pipe	300	vertical feet	$4.17	$1,300
4" Header	600	linear feet	$4.81	$2,900
Valves	45	each	$103.00	$4,600
Fittings	45	each	$35.47	$1,600
Pumps	2	each	$105.00	$200
Transfer Pumps	1	each	$221.75	$200
Transfer Piping	900	linear feet	$4.81	$4,300
Transfer Fittings	90	each	$35.47	$3,200
Sanitary Sewer Hookup	1	each	$1,316.00	$1,300
			Subtotal	$29,900
Materials				
Sheet Piling	9,000	square feet	$15.30	$137,700
Well Point System				
Well Points	30	each	$150.00	$4,500
Riser Pipe	300	vertical feet	$4.95	$1,500
4" Header	600	linear feet	$6.75	$4,100
Valves	45	each	$530.00	$23,900
Fittings	45	each	$28.35	$1,300
Pumps	2	each	$380.00	$800
Transfer Pumps	1	each	$2,232.00	$2,200
Transfer Piping	900	linear feet	$6.75	$6,100
Transfer Fittings	90	each	$28.35	$2,600
Sanitary Sewer Hookup	1	each	$0.00	$0
			Subtotal	$184,700
		TOTAL CONSTRUCTION COSTS		$226,200
Overhead and Profit at 20%				$45,200
Contingency at 30%				$67,900
				$113,100
TOTAL CAPITAL AND CONSTRUCTION COSTS				$339,300

ALTERNATIVE 2: SHEET PILE CONTAINMENT, GROUNDWATER EXTRACTION WITH WELL POINTS SANITARY SEWER DISCHARGE

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COST ANALYSIS

Item/Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
ANNUAL OPERATION AND MAINTENANCE COST				
Equipment				
System Sampling	1	lump	$800.00	$800
System Monitoring	1	lump	$800.00	$800
			Subtotal	$1,600
Labor				
Well Point System Operation	768	hours	$24.00	$18,400
System Monitoring	1	lump	$3,200.00	$3,200
			Subtotal	$21,600
Materials				
Well Point System Operation	12	months	$3,132.00	$37,600
Sanitary Sewer Disposal Fee	11,826	1,000 gallons	$6.59	$77,900
			Subtotal	$115,500
Analytical				
System Monitoring				
VOC samples	12	sample	$231.72	$2,800
TPH (purgeable) samples	12	sample	$111.04	$1,300
TPH (extractable) samples	12	sample	$112.99	$1,400
Metals samples	12	sample	$273.01	$3,300
PCB samples	12	sample	$231.72	$2,800
			Subtotal	$11,600
	ANNUAL O&M COSTS			$150,300
Overhead and Profit at 20%				$30,100
Contingency at 30%				$45,100
				$75,200
TOTAL ANNUAL O&M COSTS				$225,500
LIFETIME OPERATION AND MAINTENANCE COST				
Discount Rate	4	%		
Years	3			
	LIFETIME O&M COSTS			$625,800
TOTAL ALTERNATIVE COST				$965,100

ASSUMPTIONS
GENERAL

3 years will be used as the project life span for this cost estimate.
Sheet Pile Wall = 600' x 15' = 9,000 square feet.
Well points will be spaced every 20 feet.
A flow rate of 1 gpm will be sustained from each well point.
System monitoring will require 1 sample/month.
System operation will require 16 hours per week.
System will operate 75 percent of full time

ALTERNATIVE 3: SLURRY WALL CONTAINMENT, GROUNDWATER EXTRACTION WITH WELL POINTS, SANITARY SEWER DISCHARGE

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COST ANALYSIS

Item/Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
CONSTRUCTION COSTS				
Equipment				
Mobilization/Demobilization	1	lump	$5,000.00	$5,000
Slurry Wall	9,000	square feet	$0.45	$4,100
Well Point System				
Well Points	1	each	$2,000.00	$2,000
Riser Pipe	300	vertical feet	$0.00	$0
4" Header	600	linear feet	$0.10	$100
Valves	45	each	$1.96	$100
Fittings	45	each	$1.50	$100
Pumps	2	each	$0.00	$0
Transfer Pump	1	each	$4.30	$0
Transfer Piping	900	linear feet	$0.10	$100
Transfer Fittings	90	each	$1.50	$100
Loading and Hauling				
Dump Truck	660	cubic yards	$5.29	$3,500
Dozer	660	cubic yards	$0.94	$600
Front End Loader	660	cubic yards	$0.99	$700
			Subtotal	$16,400
Labor				
Slurry Wall	9,000	square feet	$2.70	$24,300
Well Point System				
Well Points	30	each	$41.67	$1,300
Riser Pipe	300	vertical feet	$4.17	$1,300
4" Header	600	linear feet	$4.81	$2,900
Valves	45	each	$103.00	$4,600
Fittings	45	each	$35.47	$1,600
Pumps	2	each	$105.00	$200
Transfer Pumps	1	each	$221.75	$200
Transfer Piping	900	linear feet	$4.81	$4,300
Transfer Fittings	90	each	$35.47	$3,200
Sanitary Sewer Hookup	1	each	$1,316.00	$1,300
Loading and Hauling				
Dump Truck	660	cubic yards	$2.58	$1,700
Dozer	660	cubic yards	$0.94	$600
Front End Loader	660	cubic yards	$1.19	$800
			Subtotal	$48,300
Materials				
Slurry Wall	9,000	square feet	$5.70	$51,300
Well Point System				
Well Points	30	each	$150.00	$4,500
Riser Pipe	300	vertical feet	$4.95	$1,500
4" Header	600	linear feet	$6.75	$4,100
Valves	45	each	$530.00	$23,900
Fittings	45	each	$28.35	$1,300
Pumps	2	each	$380.00	$800
Transfer Pumps	1	each	$2,232.00	$2,200
Transfer Piping	900	linear feet	$6.75	$6,100
Transfer Fittings	90	each	$28.35	$2,600
Sanitary Sewer Hookup	1	each	$0.00	$0
Soil Treatment Pad	660	cubic yards	$26.00	$17,200
			Subtotal	$115,500
		TOTAL CONSTRUCTION COSTS		$180,200
Overhead and Profit at 20%				$36,000
Contingency at 30%				$54,100
				$90,100
TOTAL CAPITAL AND CONSTRUCTION COSTS				$270,300

ALTERNATIVE 3: SLURRY WALL CONTAINMENT, GROUNDWATER EXTRACTION WITH WELL POINTS, SANITARY SEWER DISCHARGE

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COST ANALYSIS

Item/Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
ANNUAL OPERATION AND MAINTENANCE COST				
Equipment				
System Sampling	1	lump	$800.00	$800
System Monitoring	1	lump	$800.00	$800
			Subtotal	$1,600
Labor				
Well Point System Operation	768	hours	$24.00	$18,400
System Monitoring	1	lump	$3,200.00	$3,200
			Subtotal	$21,600
Materials				
Well Point System Operation	12	months	$3,132.00	$37,600
Sanitary Sewer Disposal Fee	11,826	1,000 gallons	$6.59	$77,900
			Subtotal	$115,500
Analytical				
System Monitoring				
VOC samples	12	sample	$231.72	$2,800
TPH (purgeable) samples	12	sample	$111.04	$1,300
TPH (extractable) samples	12	sample	$112.99	$1,400
Metals samples	12	sample	$273.01	$3,300
PCB samples	12	sample	$231.72	$2,800
			Subtotal	$11,600
	ANNUAL O&M COSTS			$150,300
Overhead and Profit at 20%				$30,100
Contingency at 30%				$45,100
				$75,200
TOTAL ANNUAL O&M COSTS				$225,500
LIFETIME OPERATION AND MAINTENANCE COST				
Discount Rate	4	%		
Years	3			
	LIFETIME O&M COSTS			$625,800
TOTAL ALTERNATIVE COST				$896,100

ASSUMPTIONS

GENERAL

3 years will be used as the project life span for this cost estimate.
Slurry Wall = 600' x 15' = 9,000 square feet.
Well points will be spaced every 20 feet.
A flow rate of 1 gpm will be sustained from each well point.
System monitoring will require 1 sample/month.
System operation will require 16 hours per week.
System will operate 75 percent of full time
A dozer, front end loader, and dump truck will move any excavated soil to the soil treatment pad.

ALTERNATIVE 4: BIOPOLYMER SLURRY WALL CONTAINMENT, GROUNDWATER EXTRACTION AN INTERCEPTOR TRENCH, SANITARY SEWER DISCHARGE

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COST ANALYSIS

Item/Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
CONSTRUCTION COSTS				
Equipment				
Mobilization/Demobilization	1	lump	$5,000.00	$5,000
Biopolymer Slurry Wall	9,000	square feet	$0.45	$4,100
Perforated Drain Pipe	600	linear feet	$6.38	$3,800
Riser Pipe	45	vertical feet	$8.27	$400
8" Header	600	linear feet	$0.11	$100
Valves	6	each	$1.96	$0
Fittings	16	each	$1.50	$0
Sump Pumps	3	each	$74.00	$200
Transfer Pump	1	each	$4.30	$0
Transfer Piping	900	linear feet	$0.10	$100
Transfer Fittings	90	each	$1.50	$100
Loading and Hauling				
Dump Truck	660	cubic yards	$5.29	$3,500
Dozer	660	cubic yards	$0.94	$600
Front End Loader	660	cubic yards	$0.99	$700
			Subtotal	$18,600
Labor				
Biopolymer Slurry Wall	9,000	square feet	$5.00	$45,000
Perforated Drain Pipe	600	linear feet	$2.33	$1,400
Riser Pipe	45	vertical feet	$4.29	$200
8" Header	600	linear feet	$6.21	$3,700
Valves	6	each	$103.00	$600
Fittings	16	each	$64.60	$1,000
Sump Pumps	3	each	$345.00	$1,000
Transfer Pumps	1	each	$221.75	$200
Transfer Piping	900	linear feet	$4.81	$4,300
Transfer Fittings	90	each	$35.47	$3,200
Sanitary Sewer Hookup	1	each	$1,316.00	$1,300
Loading and Hauling				
Dump Truck	660	cubic yards	$2.58	$1,700
Dozer	660	cubic yards	$0.94	$600
Front End Loader	660	cubic yards	$1.19	$800
			Subtotal	$65,000
Materials				
Biopolymer Slurry Wall	9,000	square feet	$14.55	$131,000
Perforated Drain Pipe	600	each	$1.54	$900
Riser Pipe	45	vertical feet	$20.77	$900
8" Header	600	linear feet	$6.30	$3,800
Valves	6	each	$530.00	$3,200
Fittings	16	each	$54.17	$900
Sump Pumps	3	each	$983.00	$2,900
Transfer Pumps	1	each	$2,232.00	$2,200
Transfer Piping	900	linear feet	$6.75	$6,100
Transfer Fittings	90	each	$28.35	$2,600
Sanitary Sewer Hookup	1	each	$0.00	$0
Soil Treatment Pad	660	cubic yards	$26.00	$17,200
			Subtotal	$171,700
	TOTAL CONSTRUCTION COSTS			$255,300
Overhead and Profit at 20%				$51,100
Contingency at 30%				$76,600
				$127,700
TOTAL CAPITAL AND CONSTRUCTION COSTS				$383,000

ALTERNATIVE 4: BIOPOLYMER SLURRY WALL CONTAINMENT, GROUNDWATER EXTRACTION AN INTERCEPTOR TRENCH, SANITARY SEWER DISCHARGE

HUNTERS POINT ANNEX SITE IR-1/21 EE/CA
COST ANALYSIS

Item/Description	Quantity	Unit	Unit Cost ($)	Total Cost ($)
ANNUAL OPERATION AND MAINTENANCE COST				
Equipment				
System Sampling	1	lump	$800.00	$800
System Monitoring	1	lump	$800.00	$800
			Subtotal	$1,600
Labor				
Trench Operation	768	hours	$24.00	$18,400
System Monitoring	1	lump	$3,200.00	$3,200
			Subtotal	$21,600
Materials				
Trench Operation	12	months	$3,132.00	$37,600
Sanitary Sewer Disposal Fee	11,826	1,000 gallons	$6.59	$77,900
			Subtotal	$115,500
Analytical				
System Monitoring				
VOC samples	12	sample	$231.72	$2,800
TPH (purgeable) samples	12	sample	$111.04	$1,300
TPH (extractable) samples	12	sample	$112.99	$1,400
Metals samples	12	sample	$273.01	$3,300
PCB samples	12	sample	$231.72	$2,800
			Subtotal	$11,600
	ANNUAL O&M COSTS			$150,300
Overhead and Profit at 20%				$30,100
Contingency at 30%				$45,100
				$75,200
TOTAL ANNUAL O&M COSTS				$225,500
LIFETIME OPERATION AND MAINTENANCE COST				
Discount Rate	4	%		
Years	3			
	LIFETIME O&M COSTS			$625,800
TOTAL ALTERNATIVE COST				$1,008,800

ASSUMPTIONS
GENERAL

3 years will be used as the project life span for this cost estimate.
Biopolymer Slurry Wall = 600' x 15' = 9,000 square feet.
A flow rate of 30 gpm will be sustained from the trench.
System monitoring will require 1 sample/month.
System operation will require 16 hours per week.
System will operate 75 percent of full time

APPENDIX G

MARCH 19, 1996
GROUNDWATER ANALYTICAL RESULTS

1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
2J939
MW1-3

Lab Name: ANAMETRIX, INC. Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: MP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-01

Sample wt/vol: 25.00 (g/mL) ML Lab File ID: MPM16301

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: not dec. ________ Date Analyzed: 03/22/96

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	0.5	U
74-83-9	Bromomethane	0.5	U
75-01-4	Vinyl Chloride	0.5	U
75-00-3	Chloroethane	2	
75-09-2	Methylene Chloride	0.5	U
67-64-1	Acetone	8	B
75-15-0	Carbon Disulfide	0.5	U
75-35-4	1,1-Dichloroethene	0.5	U
75-34-3	1,1-Dichloroethane	0.5	U
540-59-0	1,2-Dichloroethene (total)	0.5	U
67-66-3	Chloroform	0.5	U
107-06-2	1,2-Dichloroethane	0.5	U
78-93-3	2-Butanone	4	U
71-55-6	1,1,1-Trichloroethane	0.5	U
56-23-5	Carbon Tetrachloride	0.5	U
75-27-4	Bromodichloromethane	0.5	U
78-87-5	1,2-Dichloropropane	0.5	U
10061-01-5	cis-1,3-Dichloropropene	0.5	U
79-01-6	Trichloroethene	0.5	U
124-48-1	Dibromochloromethane	0.5	U
79-00-5	1,1,2-Trichloroethane	0.5	U
71-43-2	Benzene	8	
10061-02-6	trans-1,3-Dichloropropene	0.5	U
75-25-2	Bromoform	0.5	U
108-10-1	4-Methyl-2-Pentanone	4	U
591-78-6	2-Hexanone	4	U
127-18-4	Tetrachloroethene	0.5	U
79-34-5	1,1,2,2-Tetrachloroethane	0.5	U
108-88-3	Toluene	0.9	
108-90-7	Chlorobenzene	20	
100-41-4	Ethylbenzene	0.4	J
100-42-5	Styrene	0.5	U
1330-20-7	Xylene (Total)	3	

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
2J939
MW1-3

Lab Name: ANAMETRIX, INC. Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-01

Sample wt/vol: 25.00 (g/mL) ML Lab File ID: NPM16301

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: not dec. ________ Date Analyzed: 03/22/96

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

Number TICs found: 5

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 108-20-3	DIISOPROPYL ETHER	7.01	0.8	NJ
2. 1066-40-6	SILANOL, TRIMETHYL-	7.85	2	NJ
3. 2094-97-5	1,3-OXATHIOLANE	14.37	2	NJ
4. 106-46-7	BENZENE, 1,4-DICHLORO-	19.60	1	NJ
5. 496-11-7	INDANE	20.01	7	NJ
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1A
VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
2J940
MW43A

Lab Name: ANAMETRIX, INC. Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-02

Sample wt/vol: 25.00 (g/mL) ML Lab File ID: MPM16302

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: not dec. ______ Date Analyzed: 03/22/96

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume: ______ (uL) Soil Aliquot Volume: ______ (uL

CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L

CAS NO.	COMPOUND		Q
74-87-3	Chloromethane	0.5	U
74-83-9	Bromomethane	0.5	U
75-01-4	Vinyl Chloride	0.5	U
75-00-3	Chloroethane	0.5	U
75-09-2	Methylene Chloride	0.5	U
67-64-1	Acetone	24	B
75-15-0	Carbon Disulfide	0.5	U
75-35-4	1,1-Dichloroethene	0.5	U
75-34-3	1,1-Dichloroethane	16	
540-59-0	1,2-Dichloroethene (total)	0.5	U
67-66-3	Chloroform	0.5	U
107-06-2	1,2-Dichloroethane	0.5	U
78-93-3	2-Butanone	4	U
71-55-6	1,1,1-Trichloroethane	0.5	U
56-23-5	Carbon Tetrachloride	0.5	U
75-27-4	Bromodichloromethane	0.5	U
78-87-5	1,2-Dichloropropane	0.5	U
10061-01-5	cis-1,3-Dichloropropene	0.5	U
79-01-6	Trichloroethene	0.5	U
124-48-1	Dibromochloromethane	0.5	U
79-00-5	1,1,2-Trichloroethane	0.5	U
71-43-2	Benzene	5	
10061-02-6	trans-1,3-Dichloropropene	0.5	U
75-25-2	Bromoform	0.5	U
108-10-1	4-Methyl-2-Pentanone	4	U
591-78-6	2-Hexanone	4	U
127-18-4	Tetrachloroethene	0.5	U
79-34-5	1,1,2,2-Tetrachloroethane	0.5	U
108-88-3	Toluene	0.8	
108-90-7	Chlorobenzene	9	
100-41-4	Ethylbenzene	0.6	
100-42-5	Styrene	0.5	U
1330-20-7	Xylene (Total)	5	

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
2J940
MW43A

Lab Name: ANAMETRIX, INC. Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-02

Sample wt/vol: 25.00 (g/mL) ML Lab File ID: MPM16302

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: not dec. ________ Date Analyzed: 03/22/96

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
Number TICs found: 8 (ug/L or ug/Kg) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 540-67-0	ETHANE, METHOXY-	3.54	2	NJ
2. 75-00-3	ETHYL CHLORIDE	3.82	6	NJ
3. 4551-51-3	1H-INDENE, OCTAHYDRO-, CIS-	16.92	2	NJ
4. 106-46-7	BENZENE, 1,4-DICHLORO-	19.44	2	NJ
5. 95-50-1	BENZENE, 1,2-DICHLORO-	19.59	3	NJ
6. 496-11-7	INDANE	19.99	19	NJ
7. 934-80-5	BENZENE, 4-ETHYL-1,2-DIMETHY	20.74	4	NJ
8. 3290-53-7	BENZENE, (2-METHYL-2-PROPENY	20.93	8	NJ
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1A

VOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J941
MW44A

Lab Name: ANAMETRIX, INC. Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-03

Sample wt/vol: 25.00 (g/mL) ML Lab File ID: MPM16303

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: not dec. ________ Date Analyzed: 03/22/96

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
74-87-3	Chloromethane	0.5	U
74-83-9	Bromomethane	0.5	U
75-01-4	Vinyl Chloride	0.5	U
75-00-3	Chloroethane	0.5	U
75-09-2	Methylene Chloride	0.5	U
67-64-1	Acetone	6	B
75-15-0	Carbon Disulfide	0.5	U
75-35-4	1,1-Dichloroethene	0.5	U
75-34-3	1,1-Dichloroethane	0.5	U
540-59-0	1,2-Dichloroethene (total)	0.5	U
67-66-3	Chloroform	0.5	U
107-06-2	1,2-Dichloroethane	0.5	U
78-93-3	2-Butanone	4	U
71-55-6	1,1,1-Trichloroethane	0.5	U
56-23-5	Carbon Tetrachloride	0.5	U
75-27-4	Bromodichloromethane	0.5	U
78-87-5	1,2-Dichloropropane	0.5	U
10061-01-5	cis-1,3-Dichloropropene	0.5	U
79-01-6	Trichloroethene	0.5	U
124-48-1	Dibromochloromethane	0.5	U
79-00-5	1,1,2-Trichloroethane	0.5	U
71-43-2	Benzene	0.5	U
10061-02-6	trans-1,3-Dichloropropene	0.5	U
75-25-2	Bromoform	0.5	U
108-10-1	4-Methyl-2-Pentanone	4	U
591-78-6	2-Hexanone	4	U
127-18-4	Tetrachloroethene	0.5	U
79-34-5	1,1,2,2-Tetrachloroethane	0.5	U
108-88-3	Toluene	0.5	U
108-90-7	Chlorobenzene	3	
100-41-4	Ethylbenzene	0.5	U
100-42-5	Styrene	0.5	U
1330-20-7	Xylene (Total)	0.5	U

1E
VOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

2J941
MW44A

Lab Name: ANAMETRIX, INC. Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-03

Sample wt/vol: 25.00 (g/mL) ML Lab File ID: MPM16303

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: not dec. ________ Date Analyzed: 03/22/96

GC Column: DB-624 ID: 0.53 (mm) Dilution Factor: 1.0

Soil Extract Volume:________(uL) Soil Aliquot Volume: ________(uL)

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

Number TICs found: 1

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 541-73-1	BENZENE, 1,3-DICHLORO-	20.21	1	NJ
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J939
MW1-3

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-01

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16301

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted:03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: ___

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	100	U
111-44-4	bis(-2-Chloroethyl)Ether	100	U
95-57-8	2-Chlorophenol	100	U
541-73-1	1,3-Dichlorobenzene	50	U
106-46-7	1,4-Dichlorobenzene	50	U
95-50-1	1,2-Dichlorobenzene	50	U
95-48-7	2-Methylphenol	100	U
108-60-1	2,2'-oxybis(1-Chloropropane)	100	U
106-44-5	4-Methylphenol	100	U
621-64-7	N-Nitroso-di-n-propylamine	100	U
67-72-1	Hexachloroethane	100	U
98-95-3	Nitrobenzene	100	U
78-59-1	Isophorone	100	U
88-75-5	2-Nitrophenol	100	U
105-67-9	2,4-Dimethylphenol	100	U
111-91-1	bis(2-Chloroethoxy)methane	100	U
120-83-2	2,4-Dichlorophenol	100	U
120-82-1	1,2,4-Trichlorobenzene	100	U
91-20-3	Naphthalene	100	U
106-47-8	4-Chloroaniline	100	U
87-68-3	Hexachlorobutadiene	100	U
59-50-7	4-Chloro-3-Methylphenol	100	U
91-57-6	2-Methylnaphthalene	100	U
77-47-4	Hexachlorocyclopentadiene	100	U
88-06-2	2,4,6-Trichlorophenol	100	U
95-95-4	2,4,5-Trichlorophenol	250	U
91-58-7	2-Chloronaphthalene	100	U
88-74-4	2-Nitroaniline	250	U
131-11-3	Dimethylphthalate	100	U
208-96-8	Acenaphthylene	100	U
606-20-2	2,6-Dinitrotoluene	100	U
99-09-2	3-Nitroaniline	250	U
83-32-9	Acenaphthene	100	U

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J939
MW1-3

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-01

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16301

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted:03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: ___

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
51-28-5	2,4-Dinitrophenol	250	U
100-02-7	4-Nitrophenol	250	U
132-64-9	Dibenzofuran	100	U
121-14-2	2,4-Dinitrotoluene	100	U
84-66-2	Diethylphthalate	100	U
7005-72-3	4-Chlorophenyl-phenylether	100	U
86-73-7	Fluorene	100	U
100-01-6	4-Nitroaniline	250	U
534-52-1	4,6-Dinitro-2-methylphenol	250	U
86-30-6	N-nitrosodiphenylamine (1)	100	U
101-55-3	4-Bromophenyl-phenylether	100	U
118-74-1	Hexachlorobenzene	100	U
87-86-5	Pentachlorophenol	250	U
85-01-8	Phenanthrene	100	U
120-12-7	Anthracene	100	U
86-74-8	Carbazole	100	U
84-74-2	Di-n-butylphthalate	100	U
206-44-0	Fluoranthene	100	U
129-00-0	Pyrene	100	U
85-68-7	Butylbenzylphthalate	100	U
91-94-1	3,3'-Dichlorobenzidine	100	U
56-55-3	Benzo(a)anthracene	100	U
218-01-9	Chrysene	100	U
117-81-7	bis(2-Ethylhexyl)phthalate	40	U
117-84-0	Di-n-octylphthalate	100	U
205-99-2	Benzo(b)fluoranthene	100	U
207-08-9	Benzo(k)fluoranthene	100	U
50-32-8	Benzo(a)pyrene	100	U
193-39-5	Indeno(1,2,3-cd)pyrene	100	U
53-70-3	Dibenz(a,h)anthracene	100	U
191-24-2	Benzo(g,h,i)perylene	100	U

(1) - Cannot be separated from Diphenylamine

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

2J939
MW1-3

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-01

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16301

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted:03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 10.0

GPC Cleanup: (Y/N) N pH: ___

Number TICs found: 15

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 2094-97-5	1,3-OXATHIOLANE	6.01	88	NJ
2. 2238-07-5	OXIRANE, 2,2'-[OXYBIS(METHYL	10.44	180	NJ
3. 4165-60-0	BENZENE-D5-, NITRO-	10.51	34	NJ
4. 105-60-2	CAPROLACTAM	12.81	57	NJ
5.	UNKNOWN	13.48	36	J
6. 1758-88-9	BENZENE, 2-ETHYL-1,4-DIMETHY	14.72	25	NJ
7. 0-00-0	.ALPHA.-CAMPHOLENE ALDEHYDE	15.36	48	NJ
8. 32272-48-3	THIAZOLE, 4-ETHYL-2-METHYL-	16.66	36	NJ
9. 934-34-9	2(3H)-BENZOTHIAZOLONE	17.10	23	NJ
10. 13014-24-9	BENZENE, 1,2-DICHLORO-4-(TRI	19.11	300	NJ
11. 40702-26-9	3-CYCLOHEXENE-1-CARBOXALDEHY	19.42	27	NJ
12. 115-28-6	BICYCLO[2.2.1]HEPT-5-ENE-2,3	19.55	430	NJ
13. 81-84-5	1,8-NAPHTHALIC ANHYDRIDE	19.95	40	NJ
14.	UNKNOWN	20.28	46	J
15. 80-05-7	PHENOL, 4,4'-(1-METHYLETHYLI	20.63	40	NJ
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1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J940
MW43A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16302

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted: 03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	100	E *
111-44-4	bis(-2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	6	
106-46-7	1,4-Dichlorobenzene	8	
95-50-1	1,2-Dichlorobenzene	5	U
95-48-7	2-Methylphenol	10	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-di-n-propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
111-91-1	bis(2-Chloroethoxy)methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	6	J
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	25	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	25	U
131-11-3	Dimethylphthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	10	U
99-09-2	3-Nitroaniline	25	U
83-32-9	Acenaphthene	10	U

* Sample will be reanalyzed at a dilution

SP
4/1/96.

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
2J940
MW 13A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16302

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted:03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
51-28-5	2,4-Dinitrophenol	25	U
100-02-7	4-Nitrophenol	25	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	25	U
534-52-1	4,6-Dinitro-2-methylphenol	25	U
86-30-6	N-nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	25	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
86-74-8	Carbazole	10	U
84-74-2	Di-n-butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	10	U
56-55-3	Benzo(a)anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)phthalate	4	U
117-84-0	Di-n-octylphthalate	10	U
205-99-2	Benzo(b)fluoranthene	10	U
207-08-9	Benzo(k)fluoranthene	10	U
50-32-8	Benzo(a)pyrene	10	U
193-39-5	Indeno(1,2,3-cd)pyrene	10	U
53-70-3	Dibenz(a,h)anthracene	10	U
191-24-2	Benzo(g,h,i)perylene	10	U

(1) - Cannot be separated from Diphenylamine

1F
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.
2J940
MW43 A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16302

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted: 03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___

CONCENTRATION UNITS:
Number TICs found: 20 (ug/L or ug/Kg) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1. 2094-97-5	1,3-OXATHIOLANE	6.03	9	NJ
2. 873-66-5	BENZENE, 1-PROPENYL-, (E)-	9.82	28	NJ
3. 90-02-8	BENZALDEHYDE, 2-HYDROXY-	9.95	12	NJ
4. 1587-04-8	BENZENE, 1-METHYL-2-(2-PROPE	10.48	26	NJ
5. 1005-64-7	(E)-1-PHENYL-1-BUTENE	11.41	16	NJ
6. 43219-68-7	ETHANONE, 1-(1,4-DIMETHYL-3-	12.44	10	NJ
7.	UNKNOWN	12.70	14	J
8. 585-34-2	PHENOL, M-TERT-BUTYL-	13.10	13	NJ
9.	UNKNOWN	14.03	9	J
10. 575-43-9	NAPHTHALENE, 1,6-DIMETHYL-	14.79	9	NJ
11. 1667-01-2	ETHANONE, 1-(2,4,6-TRIMETHYL	15.30	12	NJ
12. 28732-78-7	PYRIDO[2,3-D]PYRIMIDINE, 4-M	16.36	15	NJ
13. 7148-07-4	PYRROLIDINE, 1-(1-CYCLOPENTE	16.59	9	NJ
14.	UNKNOWN	17.82	12	J
15. 16308-65-9	1,3-BENZENEDICARBOXYLIC ACID	18.72	12	NJ
16. 2541-69-7	BENZ[A]ANTHRACENE, 7-METHYL-	18.89	14	NJ
17. 1919-96-6	CYCLOHEXANONE, (4-NITROPHENY	19.44	12	NJ
18. 2384-85-2	3-DECYNE	19.62	25	NJ
19. 1078-04-2	1H-INDENE, 2,3-DIHYDRO-1,1,4	19.77	14	NJ
20. 92-06-8	M-TERPHENYL	20.89	77	NJ
21.				
22.				
23.				
24.				
25.				
26.				
27.				
28.				
29.				
30.				

1B
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J941
MW44A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16303

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted:03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
108-95-2	Phenol	13	
111-44-4	bis(-2-Chloroethyl)Ether	10	U
95-57-8	2-Chlorophenol	10	U
541-73-1	1,3-Dichlorobenzene	5	U
106-46-7	1,4-Dichlorobenzene	5	U
95-50-1	1,2-Dichlorobenzene	5	U
95-48-7	2-Methylphenol	10	U
108-60-1	2,2'-oxybis(1-Chloropropane)	10	U
106-44-5	4-Methylphenol	10	U
621-64-7	N-Nitroso-di-n-propylamine	10	U
67-72-1	Hexachloroethane	10	U
98-95-3	Nitrobenzene	10	U
78-59-1	Isophorone	10	U
88-75-5	2-Nitrophenol	10	U
105-67-9	2,4-Dimethylphenol	10	U
111-91-1	bis(2-Chloroethoxy)methane	10	U
120-83-2	2,4-Dichlorophenol	10	U
120-82-1	1,2,4-Trichlorobenzene	10	U
91-20-3	Naphthalene	10	U
106-47-8	4-Chloroaniline	10	U
87-68-3	Hexachlorobutadiene	10	U
59-50-7	4-Chloro-3-Methylphenol	10	U
91-57-6	2-Methylnaphthalene	10	U
77-47-4	Hexachlorocyclopentadiene	10	U
88-06-2	2,4,6-Trichlorophenol	10	U
95-95-4	2,4,5-Trichlorophenol	25	U
91-58-7	2-Chloronaphthalene	10	U
88-74-4	2-Nitroaniline	25	U
131-11-3	Dimethylphthalate	10	U
208-96-8	Acenaphthylene	10	U
606-20-2	2,6-Dinitrotoluene	7	J
99-09-2	3-Nitroaniline	25	U
83-32-9	Acenaphthene	10	U

1C
SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.
2J941
MW44A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16303

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted: 03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
51-28-5	2,4-Dinitrophenol	25	U
100-02-7	4-Nitrophenol	25	U
132-64-9	Dibenzofuran	10	U
121-14-2	2,4-Dinitrotoluene	10	U
84-66-2	Diethylphthalate	10	U
7005-72-3	4-Chlorophenyl-phenylether	10	U
86-73-7	Fluorene	10	U
100-01-6	4-Nitroaniline	25	U
534-52-1	4,6-Dinitro-2-methylphenol	25	U
86-30-6	N-nitrosodiphenylamine (1)	10	U
101-55-3	4-Bromophenyl-phenylether	10	U
118-74-1	Hexachlorobenzene	10	U
87-86-5	Pentachlorophenol	25	U
85-01-8	Phenanthrene	10	U
120-12-7	Anthracene	10	U
86-74-8	Carbazole	10	U
84-74-2	Di-n-butylphthalate	10	U
206-44-0	Fluoranthene	10	U
129-00-0	Pyrene	10	U
85-68-7	Butylbenzylphthalate	10	U
91-94-1	3,3'-Dichlorobenzidine	20	U
56-55-3	Benzo(a)anthracene	10	U
218-01-9	Chrysene	10	U
117-81-7	bis(2-Ethylhexyl)phthalate	4	U
117-84-0	Di-n-octylphthalate	10	U
205-99-2	Benzo(b)fluoranthene	10	U
207-08-9	Benzo(k)fluoranthene	10	U
50-32-8	Benzo(a)pyrene	10	U
193-39-5	Indeno(1,2,3-cd)pyrene	10	U
53-70-3	Dibenz(a,h)anthracene	10	U
191-24-2	Benzo(g,h,i)perylene	10	U

(1) - Cannot be separated from Diphenylamine

1F

SEMIVOLATILE ORGANICS ANALYSIS DATA SHEET
TENTATIVELY IDENTIFIED COMPOUNDS

EPA SAMPLE NO.

2J941
MW44A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: MPM16303

Level: (low/med) LOW Date Received: 03/19/96

% Moisture: ______ decanted: (Y/N)___ Date Extracted:03/20/96

Concentrated Extract Volume: 1000(uL) Date Analyzed: 03/29/96

Injection Volume: 2.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___

Number TICs found: 19

CONCENTRATION UNITS:
(ug/L or ug/Kg) ug/L

CAS NUMBER	COMPOUND NAME	RT	EST. CONC.	Q
1.	UNKNOWN	8.31	5	J
2.	UNKNOWN	14.45	2	J
3. 480-63-7	BENZOIC ACID, 2,4,6-TRIMETHY	14.49	4	NJ
4. 39891-55-9	3-BENZOFURANCARBOXYLIC ACID,	14.78	4	NJ
5. 19064-68-7	PHTHALAZINE, 1-CHLORO-4-METH	15.39	3	NJ
6. 16440-97-4	1-INDANONE, 5,6-DIMETHYL-	15.55	4	NJ
7. 768-00-3	BENZENE, (1-METHYL-1-PROPENY	16.03	3	NJ
8. 1901-26-4	3-BUTEN-2-ONE, 3-METHYL-4-PH	16.10	2	NJ
9. 1201-38-3	ETHANONE, 1-(2,5-DIMETHOXYPH	16.62	2	NJ
10. 31748-14-8	1H-1,3,2-BENZODIAZABOROLE, 2	16.71	3	NJ
11.	UNKNOWN	17.04	3	J
12. 25314-91-4	ETHANONE, 1-(3-INDOLIZINYL)-	17.66	2	NJ
13. 84-15-1	O-TERPHENYL	18.79	5	NJ
14. 106-02-5	OXACYCLOHEXADECAN-2-ONE	18.93	3	NJ
15. 3389-71-7	BICYCLO[2.2.1]HEPTA-2,5-DIEN	19.56	4	NJ
16. 92-94-4	P-TERPHENYL	20.63	20	NJ
17. 92-06-8	M-TERPHENYL	20.88	14	NJ
18. 6670-13-9	2(3H)-OXAZOLETHIONE, 4,5-DIP	21.27	10	NJ
19. 5599-36-0	SILANETRIAMINE, 1-AZIDO-N,N,	21.80	10	NJ
20.				
21.				
22.				
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29.				
30.				

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

2J940
KW43A

1
INORGANIC ANALYSIS DATA SHEET

Lab Name: INCHCAPE - SAN JOSE Contract: 000000

Lab Code: ITSSJ Case No.: 05 SAS No.: 000000 SDG No.: MP205

Matrix (soil/water): WATER Lab Sample ID: 03163-02

Level (low/med): LOW Date Received: 03/19/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	63.1			P
7440-36-0	Antimony	4.5	B		P
7440-38-2	Arsenic	9.5	B		P
7440-39-3	Barium	188	B		P
7440-41-7	Beryllium	0.10	U		P
7440-43-9	Cadmium	0.20	U		P
7440-70-2	Calcium	114000		E	P
7440-47-3	Chromium	8.9	B		P
7440-48-4	Cobalt	1.0	B		P
7440-50-8	Copper	1.3	B		P
7439-89-6	Iron	960			P
7439-92-1	Lead	0.80	U		P
7439-95-4	Magnesium	297000			P
7439-96-5	Manganese	308			P
7439-97-6	Mercury	0.10	U		CV
7439-98-7	Molybdenum	0.92	B		P
7440-02-0	Nickel	9.3			P
7440-09-7	Potassium	124000			P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	0.50	U		P
7440-23-5	Sodium	2450000			P
7440-28-0	Thallium	1.9	U		P
7440-62-2	Vanadium	14.4	B		P
7440-66-6	Zinc	8.4	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1
INORGANIC ANALYSIS DATA SHEET

2J941
MW44A

Lab Name: INCHCAPE - SAN JOSE Contract: 000000

Lab Code: ITSSJ Case No.: 05 SAS No.: 000000 SDG No.: HP205

Matrix (soil/water): WATER Lab Sample ID: 03163-03

Level (low/med): LOW Date Received: 03/19/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	64.9			P
7440-36-0	Antimony	1.9	B		P
7440-38-2	Arsenic	1.4	U		P
7440-39-3	Barium	110	B		P
7440-41-7	Beryllium	0.10	U		P
7440-43-9	Cadmium	0.20	U		P
7440-70-2	Calcium	134000		E	P
7440-47-3	Chromium	3.9	B		P
7440-48-4	Cobalt	0.49	B		P
7440-50-8	Copper	2.7	B		P
7439-89-6	Iron	537			P
7439-92-1	Lead	0.80	U		P
7439-95-4	Magnesium	45700			P
7439-96-5	Manganese	825			P
7439-97-6	Mercury	0.10	U		CV
7439-98-7	Molybdenum	2.4	B		P
7440-02-0	Nickel	2.5	B		P
7440-09-7	Potassium	14300			P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	0.50	U		P
7440-23-5	Sodium	187000			P
7440-28-0	Thallium	1.9	U		P
7440-62-2	Vanadium	2.6	B		P
7440-66-6	Zinc	19.0	B		P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

2

ORGANIC ANALYSIS DATA SHEET -- EPA METHOD TPHg
ANAMETRIX, INC. (408)432-8192

Project ID : 05
Sample ID : 2J939
Matrix : WATER
Date Sampled : 3/19/96
Date Analyzed : 3/20/96
Instrument ID : HP8

Anametrix ID : 9603163-01
Lab File ID : FPM1471
% Moisture : 100.
Dilution Factor : 1.0
Conc. Units : ug/L

CAS No.	COMPOUND NAME	REPORTING LIMIT	AMOUNT DETECTED	Q
3333-33-3	Gasoline	50.	210.	E

GC/TPH - PAGE

1D PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J939
MW1-3

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-01

Sample wt/vol: 1000 (g/mL) ML Lab File ID: EPM16301

% Moisture: ______ decanted: (Y/N)___ Date Received: 03/19/96

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 03/20/96

Concentrated Extract Volume: 10000 (uL) Date Analyzed: 04/06/96

Injection Volume: 1.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.025	JP
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.010	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.072	JP
33213-65-9	Endosulfan II	0.076	JP
72-54-8	4,4'-DDD	0.20	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.035	JP
53494-70-5	Endrin ketone	0.10	U
7421-36-3	Endrin aldehyde	0.10	U
5103-71-9	alpha-Chlordane	0.050	U
5103-74-2	gamma-Chlordane	0.050	U
8001-35-2	Toxaphene	3.0	U
12674-11-2	Aroclor-1016	0.5	U
11104-28-2	Aroclor-1221	0.5	U
11141-16-5	Aroclor-1232	0.5	U
53469-21-9	Aroclor-1242	0.5	U
12672-29-6	Aroclor-1248	0.5	U
11097-69-1	Aroclor-1254	1.4	P
11096-82-5	Aroclor-1260	2.2	P

1D
PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J940
mw43A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: HP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-02

Sample wt/vol: 1000 (g/mL) ML Lab File ID: EPN16302

% Moisture: ______ decanted: (Y/N)___ Date Received: 03/19/96

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 03/20/96

Concentrated Extract Volume: 10000(uL) Date Analyzed: 04/06/96

Injection Volume: 1.0(uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.010	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.13	P
33213-65-9	Endosulfan II	0.084	JP
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
7421-36-3	Endrin aldehyde	0.10	U
5103-71-9	alpha-Chlordane	0.050	U
5103-74-2	gamma-Chlordane	0.031	JP
8001-35-2	Toxaphene	3.0	U
12674-11-2	Aroclor-1016	0.5	U
11104-28-2	Aroclor-1221	0.5	U
1114-16-5	Aroclor-1232	0.5	U
53469-21-9	Aroclor-1242	0.5	U
12672-29-6	Aroclor-1248	0.5	U
11097-69-1	Aroclor-1254	2.0	
11096-82-5	Aroclor-1260	3.4	

1D

PESTICIDE ORGANICS ANALYSIS DATA SHEET

EPA SAMPLE NO.

2J941
MW 44A

Lab Name: ANAMETRIX Contract:

Lab Code: ANAMET Case No.: 05 SAS No.: SDG No.: MP205

Matrix: (soil/water) WATER Lab Sample ID: 9603163-03

Sample wt/vol: 1000 (g/mL) ML Lab File ID: EPM16303

% Moisture: ______ decanted: (Y/N)___ Date Received: 03/19/96

Extraction: (SepF/Cont/Sonc) SEPF Date Extracted: 03/20/96

Concentrated Extract Volume: 10000 (uL) Date Analyzed: 04/06/96

Injection Volume: 1.0 (uL) Dilution Factor: 1.0

GPC Cleanup: (Y/N) N pH: ___ Sulfur Cleanup: (Y/N) N

CAS NO.	COMPOUND	CONCENTRATION UNITS: (ug/L or ug/Kg) UG/L	Q
319-84-6	alpha-BHC	0.050	U
319-85-7	beta-BHC	0.050	U
319-86-8	delta-BHC	0.050	U
58-89-9	gamma-BHC (Lindane)	0.050	U
76-44-8	Heptachlor	0.050	U
309-00-2	Aldrin	0.050	U
1024-57-3	Heptachlor epoxide	0.010	U
959-98-8	Endosulfan I	0.050	U
60-57-1	Dieldrin	0.10	U
72-55-9	4,4'-DDE	0.10	U
72-20-8	Endrin	0.13	P
33213-65-9	Endosulfan II	0.081	JP
72-54-8	4,4'-DDD	0.10	U
1031-07-8	Endosulfan sulfate	0.10	U
50-29-3	4,4'-DDT	0.10	U
72-43-5	Methoxychlor	0.50	U
53494-70-5	Endrin ketone	0.10	U
7421-36-3	Endrin aldehyde	0.10	U
5103-71-9	alpha-Chlordane	0.050	U
5103-74-2	gamma-Chlordane	0.030	JP
8001-35-2	Toxaphene	3.0	U
12674-11-2	Aroclor-1016	0.5	U
11104-28-2	Aroclor-1221	0.5	U
11141-16-5	Aroclor-1232	0.5	U
53469-21-9	Aroclor-1242	0.5	U
12672-29-6	Aroclor-1248	0.5	U
11097-69-1	Aroclor-1254	1.9	P
11096-82-5	Aroclor-1260	3.3	

ENVIROFORMS/INORGANIC CLP

SAMPLE NO.

1

INORGANIC ANALYSIS DATA SHEET

2J939
MW1-9

Lab Name: INCHCAPE - SAN JOSE Contract: 000000

Lab Code: ITSSJ Case No.: 05 SAS No.: 000000 SDG No.: NP205

Matrix (soil/water): WATER Lab Sample ID: 03163-01

Level (low/med): LOW Date Received: 03/19/96

% Solids: 0.0

Concentration Units (ug/L or mg/kg dry weight): UG/L

CAS No.	Analyte	Concentration	C	Q	M
7429-90-5	Aluminum	78.9			P
7440-36-0	Antimony	11.3			P
7440-38-2	Arsenic	12.5			P
7440-39-3	Barium	862			P
7440-41-7	Beryllium	0.10	U		P
7440-43-9	Cadmium	0.20	U		P
7440-70-2	Calcium	101000		E	P
7440-47-3	Chromium	13.5			P
7440-48-4	Cobalt	15.4	B		P
7440-50-8	Copper	12.0			P
7439-89-6	Iron	19700			P
7439-92-1	Lead	1.4	B		P
7439-95-4	Magnesium	266000			P
7439-96-5	Manganese	624			P
7439-97-6	Mercury	0.13	B		CV
7439-98-7	Molybdenum	21.0			P
7440-02-0	Nickel	315			P
7440-09-7	Potassium	39900			P
7782-49-2	Selenium	2.3	U		P
7440-22-4	Silver	0.50	U		P
7440-23-5	Sodium	460000			P
7440-28-0	Thallium	1.9	U		P
7440-62-2	Vanadium	12.1	B		P
7440-66-6	Zinc	323			P

Color Before: COLORLESS Clarity Before: CLEAR Texture:

Color After: COLORLESS Clarity After: CLEAR Artifacts:

Comments:

APPENDIX H

RESPONSES TO COMMENTS ON THE
DRAFT AND DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
SITE IR-1/21: INDUSTRIAL LANDFILL GROUNDWATER PLUME

RESPONSE TO AGENCY COMMENTS ON
DRAFT AND DRAFT FINAL ENGINEERING EVALUATION/COST ANALYSIS
FOR HUNTERS POINT SHIPYARD SITE IR-1/21
INDUSTRIAL LANDFILL GROUNDWATER PLUME

This document presents the Navy's responses to comments on the draft engineering evaluation/cost analysis (EE/CA) for Site IR-1/21, Hunters Point Shipyard (HPS), dated March 13, 1996. The responses to comments have been further revised based on verbal discussions with the regulatory agencies on the Navy's responses to comments presented in the draft final EE/CA, dated May 24, 1996. The comments addressed below were received on April 15, 1996 from the California Regional Water Quality Control Board, San Francisco Bay Region (RWQCB); the California Department of Toxic Substances Control (DTSC); and the U.S. Environmental Protection Agency (EPA).

RESPONSE TO COMMENTS FROM THE RWQCB

Specific Comments

1. **Comment:** **Introduction, page 3, second paragraph, fourth sentence: "The Navy believes that the screening criteria are conservative (in determining potential impacts to warrant a removal action) since site specific fate and transport information and ambient levels in surface water are not integrated into the assessment."**

Page 32: "The Navy proposes a two-tiered approach (Bay and Estuaries Objectives and Ambient Water Quality Criteria) for identifying areas that warrant a removal action at Site IR 1/21."

Page 33: "The Navy believes that addressing all groundwater at HPS that exceeds bay and estuary plan objectives is not economically feasible. In addition site specific background and fate and transport evaluations will influence the threat evaluations. Therefore the Navy believes that it may not be appropriate to use bay and estuary objectives to trigger groundwater removal actions at HPS."

These statements appear to contradict one another. What is the justification for implementing a removal action at IR 1/21?

Response: The text of the EE/CA report will be clarified to reflect the removal action justification to be the following:

> Based on discussions with the regulatory agencies, the Navy evaluated analytical results using two different sets of screening criteria. One set of screening criteria (referred to as Tier 1) was based on the water quality objectives for protection of human health and aquatic life listed in the Enclosed Bays and Estuaries Plan published by the State Water Resources Control Board (SWRCB). The second set of screening criteria (referred to as Tier 2 by the Navy in the draft EE/CA) was based on the most stringent of the various ambient water quality criteria and basin plan objectives published by RWQCB.

The Navy evaluated the groundwater analytical data using both the Tier 1 and Tier 2 screening criteria, and the results were described in the draft EE/CA report. The Navy did not agree to conduct a removal action based only on the Tier 1 screening criteria.

After the Draft EE/CA Report was submitted, a meeting with the Navy and regulatory agencies was held on May 7, 1996, and the parties agreed to remove the tiered screening approach. In its place, groundwater data was screened using the water quality objectives for protection of human health and aquatic given in the Enclosed Bays and Estuaries Plan published by the State Water Resources Control (SWRCB 1993). However, the results of the screening do not alone identify areas of concern requiring a removal action. Areas of concern will be identified based on the magnitude and number of times a compound is detected in conjunction with the results of the screening.

The process of identifying and using groundwater screening criteria acceptable to the Navy and the regulators is not yet complete. Outstanding issues to be resolved as part of this effort include the (1) selection of a group or combination of groups of risk numbers which can be used for screening criteria and (2) consideration of groundwater ambient levels. Currently, the Navy is working with the agencies on a study to identify Hunters Point Groundwater Ambient Levels (HGALs). Selection of appropriate screening criteria and use of HGALs will be conducted within the Draft Final Parcel B (Feasibility Study) (FS) since that document will be the first proposed remedial action for groundwater at HPS. If more time is needed to resolve the screening criteria and HGALs issues than is allowed by the FS schedule, the Record of Decision (ROD) will include as a condition, a description of the process to be used. Final screening levels would then be identified in the remedial design phase for Parcel B.

2. Comment: **Section 2.7 Source, Nature and Extent of Contamination, first paragraph: Please define general chemical contaminant groups?**

Response: General chemical contaminant groups are chemicals not considered hazardous. The text has been revised to eliminate the categorization of hazardous and general chemical contaminant groups.

3. Comment: **Page 36, Table 6: Tier 2 values are a mixture of <u>acute and chronic values.</u> Values indicated should cite the reference source(s) and limiting factors (e.g. POLs, acute values only, etc.).**

Response: Based on the meeting held May 7, 1996, Table 6 has been revised to remove the Tier 1 and Tier 2 screening columns. The table now lists the water quality objectives for the protection of human health and aquatic life listed in the Enclosed Bays and Estuaries Plan (SWRCB 1993).

4.	Comment:	**Table 7, Notes item #4: These values are not expressed in mg/L.**
	Response:	Table 7 has been revised in response to this comment.
5.	Comment:	**Location specific ARARs [applicable or relevant and appropriate requirements], Page 44, fifth paragraph: It is not clear if this removal action will impact areas designated as wetlands within Parcel E. See also Table 8.**
	Response:	The Navy conducted a wetland delineation survey in 1994 and identified the presence and extent of wetlands at HPS (PRC 1994). Based on the findings of that report, the proposed removal action will not occur in any area delineated as wetlands. However, as stated in the text of the EE/CA report (Section 5.2.2), the Navy will consult with the U.S. Army Corps of Engineers to ensure compliance with this ARAR to the extent practicable.

RESPONSE TO COMMENTS FROM DTSC

General Comments

1.	Comment:	**According to this report, the Navy will undertake additional field work prior to finalizing the EE/CA and conducting the removal action. In the last section of the Executive Summary, the Navy states "conclusions and recommendations presented in this EE/CA should be revised after these objectives are met." It is not clear why review and comment on the scope and the alternatives of the EE/CA when the report is subject to substantial revision.**
	Response:	Additional field work is required before the recommended alternative is implemented due to the limited amount of available data on subsurface soil conditions, subsurface lithology, and groundwater contamination. The groundwater analytical data available are from 1992 sampling events. The EE/CA alternative evaluations are based on these data. However, the groundwater contaminant plume may have changed between 1992 and the present. These changes could include reduced contaminant concentrations or an expanded plume area. In the case of reduced contaminant concentrations, a removal action may not be warranted. In the case of an expanded plume, the extent of the removal action may have to be expanded. Preliminary results from groundwater samples taken March 19, 1996 from wells near the bay indicate that contaminant concentrations have decreased since 1992, but not below screening criteria levels. Therefore, the removal action is still warranted. The remainder of additional field work will be conducted during Phase I of construction. Phase I is described in detail in the Site IR-1/21 implementation work plan submitted May 1, 1996 (PRC 1996). Phase I will include cone penetrometer tests (CPTs) and HydroPunch groundwater samples. CPTs are necessary because current borelog data are not sufficient to determine whether sheet piling can be driven unobstructed along the alignment path depicted in Figure 7 of the draft and draft final EE/CA report, nor are the data sufficient to determine the depth to Bay Mud along the alignment path. These two factors, subsurface conditions and depth to Bay Mud, are critical to the effectiveness of containment using sheet piling. Results from the geological

and subsurface sampling could indicate that some areas along the alignment path of the containment wall may contain obstructions. In this case, the alignment path of the containment wall could be adjusted to avoid the obstructions, or a containment wall other than sheet pile would be used in the areas of obstruction. HydroPunch samples will be necessary to confirm the extent of sheet pile needed to fully capture the contaminant plume.

The additional data are not expected to change the scope or objectives of the removal action, which is intended to prevent contaminated groundwater from migrating into the bay. The area identified in the draft EE/CA as warranting a removal action is not expected to change. The additional data may, however, change the length as well as the type of containment wall. The text stating that the EE/CA may be revised when results of additional field work have been evaluated is intended to preserve some flexibility in implementing the removal action as more data become available.

2. Comment: **The goals and objectives of this removal action need to be articulated and sustained throughout the report. The report lacks clarity in defining the scope, delineating the area of concern and selecting removal action target levels.**

Response: The text in Section 1.1 will be revised to more clearly state that the objective of the removal action is to prevent potential immediate threats to human health (via ingestion of fish) and the environment (that is, San Francisco Bay) posed by groundwater contamination, in accordance with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 Code of Federal Regulations (CFR) Part 300 § 300.415 b[2](i). The text will be further revised to clarify that the scope of the removal action is containment of groundwater contamination. Sections 2.7.2.1, 2.7.2.2, and 2.8.3 of the EE/CA all discuss the rationale for delineating the area of concern. These sections present data that identify the proximity of chemical concentrations to the bay and the magnitude and number of times chemical concentrations were detected, and identify an area that warrants a removal action.

3. Comment: **To be consistent with the overall cleanup scheme, the Navy needs to explain how this removal action will fit into the Parcel E overall remediation. As we have requested, the Navy is in the process of evaluating feasibility of several remedial technologies at Parcel E.**

Response: The Navy has not yet begun the feasibility study (FS) for Site IR-1/21 and therefore, cannot accurately state in specific terms in the EE/CA how this removal action will fit into the Parcel E overall remediation. However, presumptive remedies for landfill closures consist of containing landfill contents and preventing migration of contamination (EPA 1993). This removal action can be integrated into a presumptive remedy for landfill closure. The removal action is designed to contain contaminated groundwater and prevent migration. However, this action can be readily expanded by extending the sheet pile wall along the shoreline and adding well points if the remedial investigation/feasibility study (RI/FS) final remedy concludes that additional containment of groundwater is required.

The text will be revised to clarify that the Parcel E overall remediation has not been defined.

4. **Comment:** **The Department believes that information regarding the wetlands at Parcel E must be included in the EE/CA. The BRAC [Base Realignment and Closure] Cleanup Plan of 1995 provides maps that identify wetlands at Hunters Point. Wetland contamination, protection and restoration need to be included in this EE/CA. ARARs related to the wetlands must be identified as well.**

Response: The Navy conducted a wetland delineation survey in January 1994 at Site IR-1/21 (PRC 1994). The nearest wetland boundary to the removal action area has been identified in Figure 7 of the final EE/CA. Groundwater levels in monitoring wells indicate that the groundwater is not connected to the wetland surface water. Therefore, including protection and restoration of wetlands at Site IR-1/21 in this removal action is not necessary. This removal action addresses containment of contaminated groundwater only. No aspects of the proposed removal action will physically occur in or affect wetland areas; therefore, wetlands will be protected but not restored.

5. **Comment:** **This report should discuss the TPH [total petroleum hydrocarbon] contamination and its cleanup. The Navy needs to state how TPH contaminated groundwater will be addressed. It is not sufficient to group the TPH as "general contaminants" and postpone the cleanup for future.**

Response: The Site IR-1/21 removal action is based on evaluating contamination that poses a potential immediate threat to human health or the environment. This evaluation is based on chemical toxicity data. There are no toxicity data for TPH. Therefore, this removal action addresses TPH in groundwater on a TPH-constituent basis (benzene, toluene, ethylbenzene, xylene, naphthalene). These constituents have been evaluated using the screening criteria.

The text will be revised to clarify that all chemical contamination in the groundwater is evaluated on a constituent basis against the screening criteria.

6. **Comment:** **As proposed by the Navy, the extracted contaminated groundwater will be discharged into POTW [publicly owned treatment works] via the sewer system. However, the Navy has not discussed the possibility of leakage from known cracks in the system. Any attempt to discharge treated or untreated contaminated groundwater into the sewer system must address the possibility of cross contamination. In addition, assurances must be provided that the POTW will accept both the volume and nature of groundwater contamination. Radioactive waste has been detected in the groundwater, however; it is not carried through the criteria. It is not clear if the POTW is permitted to accept radioactive waste.**

Response: As part of the implementation work plan, the sanitary sewer line used for groundwater discharge will be surveyed for structural integrity and repaired if any infiltrating groundwater is unacceptable for discharge to the POTW.

The POTW has been contacted regarding the anticipated contamination concentrations and volume of the extracted groundwater and confirmed that the groundwater would be accepted if discharge requirements were met.

The radiation detections shown in Table 2 of the draft EE/CA are invalid results and should not have been presented in the report. The gross alpha/beta results were evaluated and determined to be unusable because the high total dissolved solids (TDS) concentrations in the groundwater interfered with the laboratory analysis. In addition, new data show that there is no radiation in the groundwater. This is documented in the Surface Confirmation Radiation Survey Draft Report (PRC 1992).

Specific Comments

7. **Comment:** **Section 1.1: Please explain why samples collected and validated so far are not considered complete and the Navy is contemplating taking additional samples. Additionally, please explain how often chemicals are to be observed before they are considered "consistently" detected. Please explain which wells will have to be further sampled.**

Response: Wells IR01MWI-3, IR01MW43A, and IR01MW44A were sampled on March 19, 1996. These wells were selected because previous analyses of samples from these wells indicated that polychlorinated biphenyl (PCB) contamination was present at levels above screening criteria. These wells are near the bay and are along the proposed alignment path of the removal action. These wells were last sampled in August 1992 and the Navy believed confirmation of the contamination was prudent before the removal action progressed further. These wells were sampled for the following analytes on March 19, 1996: PCBs/pesticides, metals (filtered), semivolatile and volatile organic constituents, TPH purgeables and TPH extractables, total recoverable petroleum hydrocarbons (TRPH), pH, salinity, and anions.

The PCBs/pesticides, metals, and semivolatile samples were submitted for expedited analysis. All other samples were submitted for normal laboratory turnaround. Results of the preliminary unvalidated PCB analyses indicate that the concentrations have been reduced by approximately an order of magnitude in samples from all three wells since 1992. However, concentrations still exceed screening criteria.

Additional data on the concentrations and extent of contamination will be gathered by HydroPunch sampling during the initial stages of construction.

8. **Comment:** **Section 2.4.3: It is important to state the characteristics of the B aquifer. To be consistent with the objective, "to reduce the risk of the environment," the B aquifer should be evaluated and if found to be adversely impacting the Bay, it will need to be addressed in this EE/CA.**

Response: Section 2.7.2.1 summarizes the contamination found in the B-aquifer within Site IR-1/21. The text states that the contamination found in the B-aquifer appears to be insignificant, and that the B-aquifer will not be included in the removal action as a result. The text has been revised to clarify that groundwater data indicate the B-aquifer flows upward to the A-aquifer. In addition, the low-level contamination found in samples from B-aquifer well IR01MW02B is located inland from the bay. Any contaminant migration to the bay would be subject to dilution. It is unlikely that the contaminant concentrations would pose a threat to human health and the environment by the time they reached the bay, because dilution would have decreased the concentrations.

9. **Comment:** **Section 2.7.2.1: Concentrations provided must be examined for accuracy. The OU1 [Operable Unit 1] Phase IIA data indicate concentrations that are higher than shown in Table 1.**

Response: OU1 Phase IIA data apply to monitoring wells IR01MW42A and IR01MW41A only for Site IR-1/21. Contaminant levels from Phase IIA data for these wells are below those presented in Table 1.

10. **Comment:** **Section 2.8.2: It seems that the Navy has adopted selective and arbitrary criteria to undertake the removal action. These criteria have limited the scope of the removal action to a confined area while threats to the bay and the wetlands are not fully evaluated. Further, since the Navy has not conducted a feasibility study, it is premature to state that "addressing the groundwater at HPA that exceeds bay and estuary plan objectives is not economically feasible."**

Response: Refer to the Navy's response to RWQCB specific comment 1 for the criteria used to undertake this removal action. Based on the meeting held May 7, 1996, the criteria selected as a basis for the decision to undertake a removal action have been revised in Section 2.8.3. The stringent screening criteria (published in the Enclosed Bays and Estuaries Plan [SWRCB 1993]) used in the draft final EE/CA are conservative so as not to limit the identification of removal action areas.

As stated in the response to DTSC general comment 4, there is no threat to the wetlands via contaminated groundwater. The text in the EE/CA report has been revised to clearly state that the scope of the removal action is contaminated groundwater containment and not final remediation of Site IR-1/21. Final remediation will be determined during the ongoing RI/FS.

The statement that "addressing the groundwater at HPA that exceeds bay and estuary plan objectives is not economically feasible" has been deleted from Section 2.8.3.

11. **Comment:** **Section 3.1: It is not clear how inorganic contamination is decided to "not to be considered" in this removal action. The landfill has been used by the Navy as a hazardous waste disposal site for many years. It is thus considered a source of, among others, metal contamination. Excluding the inorganic from the removal action implies that the Navy plans to segregate the organic and inorganic contamination in the groundwater.**

Response: Section 2.8.3 presents an account of inorganic chemicals detected in groundwater in samples from wells near the bay. Some metals, such as nickel and copper, have been detected consistently throughout HPS, and the concentrations appear to be attributable to background levels. An inorganic background study is not available at this time to use as a comparison to confirm that some inorganic contamination is within ambient levels. However, the Navy considers the information available (surrounding geology, widespread detections, spatial distribution) as evidence to support the position of not including some metals detected in the groundwater in this removal action.

The Navy has not determined that all inorganic contamination will be excluded from this removal action. For example, beryllium is identified as a chemical of concern in well IR01MW44A. This well is included in the removal action area. Refer to the response to RWQCB specific comment 1 for further explanation of determining ambient levels of inorganic compounds in groundwater at HPS.

12. Comment: **Section 3.2: It is not clear if the objective of this removal action is to "mitigate the spread of contaminants" or as it is stated in the Executive Summary to "reduce the risk to the environment." These two objectives require different analysis and criteria. Further, the Navy needs to explain how limiting the removal action to a specific area by applying selective criteria will achieve the objective of this removal action.**

Response: The text has been revised to clarify that the objective of the removal action is to protect human health and the environment from immediate potential threats posed by groundwater contamination. Threats to human health could result from exposure through the ingestion of fish. Threats to the environment could result from exposure to groundwater through migration into San Francisco Bay. No risk assessments, either ecological or human, have been performed on Parcel E at this time.

Based on the meeting held May 7, 1996, the criteria selected as a basis for the decision to undertake a removal action have been revised in Section 2.8.3.

13. Comment: **Tables 3 and 4: To undertake the removal action, it is important to articulate the reason(s) behind drawing a line 180 feet from the bay. It is not clear how the objective of this removal action is met by only considering the area within 180 feet from the bay.**

Response: The distance of 180 feet was not used to define the area warranting a removal action. As stated in Section 2.7.2.2, seven monitoring wells were selected along the bay shore to provide the most accurate representation of groundwater chemistry nearest the bay. The objective of the removal action is to protect potential receptors from contaminated groundwater, and the potential exposure pathway begins at the shoreline.

The seven wells are located at varying distances from the shore, but they are still the closest wells along the entire shore boundary of Site IR-1/21. They were not selected based on a specific distance from the shore. The distances reported in Tables 3 and 4 are important information for use later in the report to approximate the boundary of the plume. The plume boundary information determines the approximate location of the containment wall.

The text has been revised to clarify the rationale for selecting the seven wells nearest the bay shore as an area of focus. In addition, references to distances within the text, 180 feet for example, have been deleted and replaced with the phrase "nearest the bay" to avoid confusion.

14. Comment: **DTSC is forwarding the following ARARs from the Department of Fish and Game. The ARARs should be incorporated in the IR-1/21 removal action.**

(1) Fish and Game Code Sections 5650(a), (b), and (f)

(2) Fish and Game Code Section 2014
(3) Fish and Game Code Sections 2080 and 1900 et seq.
(4) Fish and Game Code Sections 2080
(5) Fish and Game Code Section 2090-2096

Response: The Navy has evaluated each of the ARARs provided by the Department of Fish and Game and included in the EE/CA only those requirements applicable, relevant, or appropriate to the alternatives identified as ARARs.

Fish and Game Codes (1) and (4) above are not applicable, relevant, or appropriate to the alternatives being evaluated. No discharges to the bay will occur during the removal action, and no taking, importation, or sale of endangered species will occur during the removal action.

Fish and Game Codes (2) and (3) above have been included as ARARs in the removal action.

Fish and Game Code (5) above was already identified as an ARAR.

RESPONSE TO COMMENTS FROM U.S. EPA

General Comments

1. Comment: **A major factor in the request for revision of the draft Parcel E IR-1/21 EE/CA was the mutual decision reached between the regulatory agencies and the Navy to screen detected concentrations against the most stringent screening criteria for surface water quality. For this reason, it was agreed that the <u>Bay and Estuary Plan Objectives</u> were to be used in conjunction with <u>Ambient Water Quality Criteria</u> and <u>Regional Water Quality Control Board Basin Plan Objectives</u>, and the most stringent criteria of the three used as the screening level. Breaking the screening process into a Tier 1 and Tier 2 approach seems to defy this reasoning and statements made to justify the tiered approach are completely inadequate. [Statements on pages 32 and 33 are as follows: "The Navy wants to proceed with a removal action and incorporate regulatory requests into the decision process; therefore, it has agreed to integrate bay and estuary plan objectives and eliminated the dilution/migration factor" and the subsequent statement "Therefore, the Navy believes it may not be appropriate to use bay and estuary objectives to trigger groundwater removal actions at HPA." These two sentences are basically stating that to placate the regulatory agencies, bay and estuary numbers will be looked at as a screening criteria, but then put aside, and not used to drive any decisions regarding the groundwater removal actions.] Please come to an agreement with the Regional Water Quality Control Board as to the appropriate screening levels and subsequent decision making and then fully explain this agreement in the EE/CA. Without this background information and a clearly explained approach to deciding which contaminants pose an environmental threat, the document cannot be properly evaluated.**

Response: The Navy has not disregarded the more stringent bay and estuary numbers but has, in the spirit and intent of a removal action under the NCP, identified an area to begin removal. This area was identified for a removal action under both the Tier 1 and Tier 2 screening criteria. The area also presents the highest potential threat under both the Tier 1 and Tier 2 screening criteria. There is no other clearly definable area where contaminants were detected above either the Tier 1 or Tier 2 screening criteria. Refer to Figures 5 and 6 in the draft final or final EE/CA. The Navy's decision to undertake a removal action was based on the results of both Tier 1 and Tier 2 screening criteria. The Navy does not want to establish an excessively conservative precedent for HPS groundwater by basing the decision to undertake a removal action on only Tier 1 screening criteria.

Subsequent to submitting the Draft EE/CA Report, a meeting with the Navy and regulatory agencies was held May 7, 1996 and the parties agreed to remove the tiered screening approach. In its place, groundwater data will be screened using the water quality objectives for protection of human health and aquatic life provided in the Enclosed Bays and Estuaries Plan published by the State Water Resources Control (SWRCB 1993). However, the results of the screening do not alone identify areas of concern requiring a removal action. Areas of concern will be identified based on the magnitude and number of times a compound is detected in conjunction with the results of the screening. Groundwater remediation goals for HPS will fully evaluated during the RI/FS for Parcel E. Text has been modified in Sections 1.1 and 2.8.3 of the EE/CA to further discuss the rationale for identifying areas of concern.

2. **Comment:** **This removal action focuses on controlling PCBs into the bay from IR-1/21. HPALs [Hunters Point Ambient Levels] for groundwater are currently being calculated, and so it is difficult to determine whether concentrations of inorganics detected in monitoring well samples for this site exceed those for background conditions. Since it has been acknowledged that an evaluation of ambient conditions is beyond the scope of this EE/CA, such statements as "the spatial distribution of many metals was not characteristic of point-source- related contamination" in Section 2.7.1 and "unless strong evidence indicates inorganic compounds are Navy-related" in Section 3.1 should be deleted. Please be aware that although inorganics contamination is considered beyond the scope of this removal action, any inorganics contamination from IR-1/21 and any necessary remedial action will have to be addressed at a later date.**

Response: The statements referenced were not intended to be conclusions based on thorough consideration of the background levels of inorganic constituents in the groundwater. Rather, the Navy considers the statements to be supportable based on the results of the screening process for groundwater conducted as part of this and other removals. The Navy is working with the regulatory agencies on a separate study to determine Hunters Point Groundwater Ambient Levels (HGALs). However, the statements could be inaccurately interpreted as conclusive at this time and therefore will be deleted.

3. **Comment:** **The screening criteria upon which removal action decisions for this site were based (Bay and Estuary plan objectives, RWQCB basin plan objectives and Ambient Water Quality Criteria) are not provided in the document, making it very difficult to verify the conclusions drawn. Table 6, giving Tier 2 screening levels, is confusing and needs more background information and better explanation in the footnotes (see comment (1) above). Table 9, comparing requirements, is provided for the reader yet does not answer the basic questions of whether the POTW has agreed to accept discharge from the facility generated by this removal action or whether the facility will be able to meet the indirect discharger permits requirements without treatment. Please give thought to providing information that will support recommendations and conclusions in the text.**

Response: Based on the meeting held May 7, 1996, Table 6 has been revised to remove the Tier 1 and Tier 2 screening columns. The table now lists as screening criteria the water quality objectives for the protection of human health and aquatic life given in the Enclosed Bay and Estuaries Plan (SWRCB 1993). Information provided in Notes 1 and 2 in Table 6 and in the text regarding the screening criteria has been modified to provide clarification.

The POTW has been contacted regarding the anticipated contamination and volume of the extracted groundwater and confirmed that it would be accepted if discharge requirements were met. Further information is provided in Sections 4.1.3 and 5.2.3 regarding discharge to the POTW.

4. **Comment:** **Quality control on this document should check for consistency between data presented, and provide explanations for inconsistencies. For instance, the maximum concentrations stated in Table 7 differ in some cases from the maximum concentrations given in Table 9.**

Response: These data have been checked and corrected.

5. **Comment:** **The EE/CA should not use the acronym "RA" in reference to "removal action". In CERCLA, RA refers to "remedial action," which is a final action and is not covered by an EE/CA.**

Response: Comment noted. The term "RA" has been replaced with removal action throughout the text.

6. **Comment:** **The references to ARARs in the text and in Table 8 are so general that they are not very useful. The potential requirements need to be described more specifically and discussed with specific reference to the proposed actions.**

Response: The text has been revised regarding the evaluation of alternatives to add more specificity in Sections 3.3.2.2, 5.2, 5.3, and 5.4.

7. **Comment:** **The monitoring wells with PCBs above screening levels ranged from 50 to 130 feet from the shoreline. It is not clear whether additional**

investigation is planned to evaluate the concentrations of PCBs closer to the shoreline. It is also unclear how the placement of the sheet piling in relationship to the shoreline will be determined.

Response: No additional studies are planned, at this time to evaluate concentrations of PCBs closer to the shoreline, for several reasons. First, the distances from the wells to the shoreline were conservatively calculated from existing maps using the mean sea level. The actual high-tide strand line varies but is definitely closer than indicated to each of the three wells. Second, the actual field conditions generally prohibit sampling by drilling closer to the bay. The shoreline is a relatively steep embankment in places, and the entire stretch of shoreline paralleling the proposed alignment of the sheet piling is covered with concrete rubble, reinforcing rod, and other rocky rubble as a rip rap armor. For example, at well IR01MWI-3 the slope break and rubble lie within approximately 5 feet of the well. There is no place to complete another well nor could a drilling rig drive into the area between this well and the shoreline. Therefore, taken out of physical context, these distances may be misleading.

The sheet piling will be placed parallel to the shoreline. It will be necessary to place it far enough inland to provide a solid, level ground surface for the equipment to work. The space between the sheet piling and the rip rap-covered slope will provide a space for installing downgradient monitoring wells to monitor the system's effectiveness. The CPT data generated in Phase 1 will, as stated in the text, confirm the suitability of the subsurface along the proposed alignment path for driving the sheet piling. It is anticipated that subsurface obstructions or refuse may alter the exact alignment of the sheet piling. The text has been revised to clarify the rationale for the approximate location of the containment wall.

8. Comment: **Groundwater extraction without containment was not considered as an option. The cost of groundwater extraction alone should be calculated for purposes of comparison. Conversely, another option that was not considered was containment without groundwater extraction. In general, the development of alternatives needs more technical justification. The basis for the assumed well spacing and extraction rates and for the length of the containment wall, including the reasons for not making the wall a complete circular containment structure, should be provided.**

Response: Analysis of the information indicated a high proportion of bay water would be extracted along with the contaminated water emanating from the landfill. This would have the undesirable effect of diluting the contamination and adding significantly to the water volumes for disposal, increasing POTW disposal costs. Additionally, the extraction system would enhance salt water intrusion and possibly require detailed studies to assess effects on wetlands and bay and estuary issues. The text has been revised to clarify the rationale for elimination of containment using groundwater extraction alone.

The well spacing and extraction rates are simply based on professional judgment for initiating the system. System monitoring will accumulate data to support adjustments, equipment modifications, and additional well points as needed to optimize the removal. This is a judgment made in the interest of initiating a timely removal action. Although additional data would be desirable, the time involved in creating work plans and sampling plans, subcontracting drillers, installing pumping test wells, conducting tests, reducing the data, and reporting could easily create delays of another year or more. The design would then need to be revisited, and the final result might not be much improved over the present removal action.

The length of the containment wall was chosen to extend beyond the wells showing contamination along the proposed alignment path. Before the design of the containment and hydraulic control system is finalized, a Phase 1 field program of CPT, HydroPunch water sampling, and sampling of existing wells is planned. This program will further define the lateral extent of the plume, the alignment path of the sheet piling, and the well point spacing.

The containment wall was never envisioned as a complete circular containment structure for several reasons. First, the full extent of the plume and the originating source are unknown. Defining this area would be beyond the scope of a removal action. Additionally, it would not be necessary to isolate the upgradient end of the plume as the pathway to potential receptors does not exist upgradient. Finally, full circular containment will not likely be consistent with the ultimate remedial action chosen for Parcel E.

Specific Comments

1. Comment: **Page ES-2, third paragraph: It is stated that there is a regulatory preference for discharge to the sewer system over the drain system. This statement is misleading and the reason given is incorrect. Storm drain discharge to the bay is prohibited, not by preference, but by regulation, and sewer discharge has been chosen by the Navy as the most reasonable alternative.**

   Response: The regulatory preference for discharge to a sanitary sewer is written in the June 1995 Water Quality Control Plan for Region 2 (San Francisco Bay area).

2. Comment: **Section 1, page 1, first paragraph: Update to reflect that Parcels B and C groundwater plume removal actions are no longer being pursued.**

   Response: The text has been revised to state that the Parcel B and Parcel C groundwater plume removal actions are no longer being pursued.

3. Comment: **Section 1, page 1, third paragraph: The statement "The groundwater contains relatively low concentrations of organic compounds..." does not support the need for a removal action at Site IR-1/21. It should be explained here that the levels are such that they pose a threat to the bay and aquatic life.**

   Response: The text has been revised to state that the levels of specific contaminants pose a threat to aquatic life in the bay.

4. Comment: **Section 1, page 1, third paragraph: "Hazardous substances" should be specified as those under CERCLA [Comprehensive Environmental Response, Compensation, and Liability Act].**

Response: The text has been revised to reference chemical constituents rather than chemical groups to avoid confusion.

5. **Comment:** **Section 1.1, page 3, second paragraph: The report states that "additional confirmation samples will be collected at areas where isolated detections are above screening criteria...". Please discuss how and when this sampling will be done and the impact on this removal action if these isolated detections are confirmed.**

Response: Additional samples were taken March 19, 1996, at the three wells exhibiting PCB detections in excess of screening criteria. These data have been received, in part, in a preliminary unvalidated form. The full laboratory package has not yet been received. These data are incorporated (qualified as preliminary) in Section 2.8.3 of the EE/CA. Preliminary results indicate that PCBs still exceed screening criteria in wells IR01MW-3, IR01MW43A, and IR01MW44A, although they have decreased by approximately an order of magnitude in all three wells since the last samples were collected. Detections outside of the removal area above screening criteria will be confirmed during the RI/FS process.

6. **Comment:** **Section 2.4.3, page 14: Please provide hydrogeologic characteristics such as permeability and storativity of these aquifers and discuss aquifer tests that have been performed. This information is necessary both to evaluate the proposed alternatives and for the design.**

Response: Information available for the proposed removal area has been added to Section 2.4.3. These data are so limited that they were not included in the draft EE/CA report. Existing data consist of slug test results for wells IR01MWI-3 and IR01MW43A. Analysis of data by the Cooper Method yielded a hydraulic conductivity (K) of 2.7 feet per day (ft/day) for well IR01MWI-3 and 7.7 ft/day for well IR01MW43A. No transmissivity was calculated for well IR01MWI-3 because it did not fully penetrate the aquifer. A transmissivity of 20 ft^2/day was calculated for well IR01MW43A. Storativity was not defined by slug testing. The gradient is approximately 0.0083 near the alignment path for the containment wall. There are no other data available for the area of the proposed alignment path; however, other data exist for the rest of Site IR-1/21. These data are available in the Technical Memorandum Integration of Facility-Wide Hydrogeologic Data (May 1994).

The removal action is conceptualized to be a flexible iterative process with regard to removing the groundwater. Pumping rates, number of pumps, and number of wells may be changed to achieve optimum efficiency based on observation.

7. **Comment:** **Section 2.7.1, page 19: It is confusing to have concentration data (i.e. Aroclor, Arsenic, and Lead) referenced to a monitoring well location, but then presented in mg/kg. Were these samples taken from initial soil borings that were later developed into monitoring wells? Please clarify.**

Response: These are soils data taken from borings for these respective wells. The list has been modified to clarify this point.

8. **Comment:** **Tables 1 and 2, pages 21-26: These tables would be more useful if they included the location of the maximum detection. As currently presented, it is impossible to assess whether contamination is contiguous or sporadic.**

Response: The tables have been amended to provide the locations of maximum detections.

9. **Comment:** **Section 2.8.3, page 32, second paragraph: It is not necessary to include information on possible screening scenarios that were considered but not adopted, i.e. the dilution factor criteria. If the Navy feels compelled to include this information, then an explanation that goes further than "the regulatory agencies recommended a more conservative approach" needs to be offered.**

Response: The Navy feels that it is important to show that, from among a range of approaches, the option with the most conservative initial step was used. The second paragraph has been retained and supplemented with a sentence emphasizing this point.

10. **Comment:** **Section 2.8.3, page 38, last paragraph: Appears that majority of wells (12) have hits of PCB contaminants. Why the discrepancy between the text and the figure? This paragraph also states that PAH [polycyclic aromatic hydrocarbon] and PCB detections are limited to the southeast corner, whereas Figure 5 shows PAH detections scattered over the site.**

Response: The text and figure were reviewed and PCBs were detected in only 11 wells, not 12, as shown on Figure 5. The text has been revised to clarify the locations of PCB and PAH detections.

11. **Comment:** **Figure 5: Please include a debris zone on Figure 5.**

Response: The term "debris zone" was first used by a subcontractor and was intended to imply a horizon containing landfill refuse. The term is somewhat confusing and has been removed from the text. In general, the whole area should be considered artificially filled and having a potential for containing refuse. Rather than reviewing all borelogs throughout the area in an attempt to delineate the extent of refuse, the entire area encompassed by the landfill boundary should be considered to have the potential for containing refuse.

12. **Comment:** **Section 2.8.3, page 39, third paragraph: Justification for no further consideration of nickel and copper is inadequate. Until background groundwater concentrations for these metals can be established for this site, dismissing the significance of these levels is premature.**

Response: As stated, nickel and copper do not warrant further consideration as chemicals of concern (COCs) as part of this removal. The Navy is not implying that there will be no further evaluation of nickel and copper at HPS, only that a removal action EE/CA is not a suitable document in which to evaluate potential groundwater contaminants that are ubiquitous at a large site. The Navy is currently working with the regulatory agencies on a separate study to establish HGALs.

13. **Comment:** **Table 6 and Table 7: Check Tier 1 units and/or concentrations between these two tables. In Table 7, zinc is listed as having a Tier 1 limit of 58 mg/L which is the equivalent of 58,000 μg/L, an apparent error in units. In addition to making sure all units within tables are correct, please make them consistent between columns for ease of comparison.**

Response: Table 7 has been revised in response to this comment.

14. **Comment:** **Section 2.8.3, page 39 and Table 7, first footnote: What is the basis and justification for discounting contamination that appears in only one sample or in multiple samples but only one well.**

Response: The first paragraph of Section 2.8.3, Chemicals of Concern and Areas of Concern, discussed the basic approach to establishing COCs for a removal action. The Navy has not permanently discounted these potential COCs or detections of them in the listed wells. The basis for excluding them from consideration as part of this removal action is simply the erratic nature of the detections or concentrations found, which does not positively indicate a high magnitude threat. As a result, the Navy feels it is inappropriate to base a removal action on one data point. These data will be evaluated further during the RI/FS for Parcel E.

15. **Comment:** **Section 3.3.2.2, pages 44-45, Table 8: The federal ARARs should include ARARs from the U.S. Fish and Wildlife Coordination Act 16 which prohibits water pollution with any substance deleterious to fish, plant life or bird life and requires consultation with the U.S. Fish and Wildlife Service and appropriate state agencies. Also, revise the wetland requirement to include minimizing the "destruction, loss and" degradation of wetlands.**

Response: Coordination Act 16 this is not considered a location- or action-specific ARAR for this removal action because no discharges to the bay will occur. The wetland requirement text was revised also.

16. **Comment:** **Table 8: Since PCBs are present, TSCA [Toxic Substance Control Act] should also be referenced. The wetlands citation should be to 40 CFR Part 6, Appendix A and Executive Order 11990. The remainder of the citation should be deleted. Coastal Zone Management Act cite citation to as Section 307(c) of 16 U.S.C. §§ 1451 <u>et seq.</u> should also include the cite citation to California Public Resources Code §§ 30,000 <u>et seq.</u> which is the State Coastal Management Plan. The approved coastal zone management program for San Francisco Bay includes the McAteer-Petris Act and the San Francisco Bay Conservation and Development Commission. The goals of the Bay Plan are to reduce bay fill and disposal of dredged materials in the bay and to maintain the water quality and ecological integrity of the bay. The Navy should coordinate with BCDC to make its consistency determination. AQMD [Air Quality Management District] Rules need a specific citation.**

Response: TSCA includes provisions for managing and cleaning up PCB wastes at concentrations above 50 parts per million (ppm). TSCA is not applicable to the removal action because the maximum concentrations at the site are below 50 ppm. TSCA is not relevant and appropriate because another requirement more fully matches the circumstance at the site. The California hazardous waste definition includes wastes with PCB concentrations above 50 ppm. Wastes generated during removal action construction activities with PCB concentrations that exceed hazardous waste levels will be managed in accordance with the requirements in the California Code of Regulations, Title 22, Division 4.5. Title 22 regulations are protective and include provisions for managing, storing, and disposing of wastes. The California Public Resources Code is not considered a location- or action-specific ARAR because no discharges to the bay will occur.

17. **Comment:** **Section 4.1.1.1, page 47, second paragraph: Discuss the effects of salinity on the performance of bentonite and any potential effect on permeability of the slurry wall.**

Response: Text has been added to the EE/CA that discusses the effects of salinity on the performance of bentonite and any potential effect on the permeability of the slurry wall.

18. **Comment:** **Section 4.1.1.3, second paragraph: States "Pile driving requires a relatively uniform, loose soil profile free of boulders and large refuse or debris for area construction..." Having described the landfill as consisting in part of debris and boulders, will pile driving activities be a reasonable choice?**

Response: Impediments to driving sheet piling are possible; however, soil borings indicate that the area along the proposed containment wall alignment path is free of large debris. The need to evaluate subsurface conditions along the proposed alignment path of the containment wall will be partially satisfied by the predesign field program. The use of CPTs on 25-foot centers along the proposed alignment path is intended to provide data for pile driving. Data on ease of penetration and depth to the Bay Mud will also be generated. Borings for the three A-aquifer and one B-aquifer wells along the alignment path were all drilled by hollow-stem auger, which would indicate the relative ability to penetrate the fill. Blow counts from driving split spoons in these borings also indicate the nature of the fill. These data are assembled in the Removal Action Implementation Work Plan (PRC 1996).

19. **Comment:** **Section 4.1.3, page 52, second paragraph: This paragraph retains discharge to the sanitary sewer as a treatment option. Although contaminant concentrations may be acceptable, there is no discussion on whether this approach will be allowable by the POTW. This section should include a discussion of the likelihood of the POTW accepting contaminated water from the site, with the attention given to accepting brackish or saline water.**

Response: The POTW was contacted to verify acceptance of groundwater. Text has been added to support the discharge to the POTW. The sheet piling will minimize the brackish or saline water extracted and discharged.

20. **Comment:** **Section 4.1.4.1, page 53: This section eliminates the reaction walls based on trenching costs. These costs are not likely to be cost prohibitive since the depth of the trench is only about 20 feet. In addition, slurry walls in Section 4.1.1.1 were not eliminated for cost reasons, so it appears inconsistent to dismiss reaction walls. The frequency of replacement over three years would not be expected to be significant; please explain how**

much repeated trenching is needed, why it is needed and why this makes the option cost prohibitive.

Response: Elimination of reaction walls due to removal and retrenching costs is not inconsistent with retaining a single installation for a slurry wall. The cost for removal and disposal as well as the reinstallation of a reaction wall even one time over 3 years is expected to be more than double the cost of the single installation of a slurry wall trench. Additionally, the removed material would likely require disposal at a Resource Conservation and Recovery at (RCRA)-permitted landfill.

21. **Comment:** **Section 5.2.1, page 59: Please discuss any modeling or calculations that have been performed to determine the adequacy of the proposed wall, including such factors as direction of groundwater flow at the ends of the wall. To what radial extent are the suction pumps capable of drawing water?**

Response: The data are so sparse that any modeling of the system as a whole would involve using many arbitrary parameters as model inputs. However, single well capture zones, based on the hydraulic data for the two existing wells along the proposed alignment path, are currently being evaluated to support the Removal Action Implementation Work Plan (PRC 1996).

Groundwater flow at the end of the alignment path is expected to be toward the end wells. The preconstruction HydroPunch data will be collected to attempt to define the lateral extent of the PCB plume and to design the system to capture its total width.

The radial extent of the effects of the pumps is subject to many variables, so an exact number cannot be presented at this time. However, the system will be designed to be effective or will be modified on observation to be effective in capturing the plume.

22. **Comment:** **Section 5.2.1: How will the screens used for the well points be prevented from clogging with the fines typical of artificial fill geology?**

Response: The screens as proposed will be designed to use screens and sandpacks appropriate for the material screened. It is anticipated, based on our landfill experience, that these well points will still become clogged by sediment, bacterial fouling, and refuse. Therefore, the screens will house a drop pipe that will use suction lift to remove the water. The wellhead assembly and drop pipe will be removable to facilitate mechanical cleaning and redevelopment during normal operation and maintenance, as needed. The advantage of the proposed pumps is their ability to continue pumping without burning out or being destroyed by sediment if a screen clogs.

23. **Comment:** **Section 5.2.2, page 60, second paragraph: The sentence that begins "The only action-specific ARAR for Alternative 2.." should be changed from singular to plural. The reference is to both air and hazardous waste management requirements and both requirements need to be more specifically identified.**

Response: Air emissions are not expected to be associated with Alternative 2. The sentence has been modified to eliminate the air emissions ARAR.

24. **Comment:** **Section 5.2.3, page 63: This section should include a discussion of the permits needed for discharge to the POTW and the likelihood of POTW acceptance of the waste stream into their facility.**

Response: The section has been expanded to state that the POTW has indicated that it could handle the proposed discharge and that the Navy must obtain a discharge permit from the POTW.

25. **Comment:** **Section 5.2.4, page 63: The costs for removal of the sheet piling should also be included unless the sheet piling is to be left in place.**

Response: The containment system depends on the sheet piles remaining in place; therefore, removal costs are not included. Decommissioning the removal action is not part of this evaluation.

26. **Comment:** **Section 5.3.1, page 64: Describe what is to be done with the trench spoils. Disposal of this soil could be costly.**

Response: The description of the slurry wall alternative has been expanded to state that trench spoils will be treated on site, and that treated soil will be used as backfill or subbase for a landfill cap if the landfill is capped later. The costs were included under the soil treatment pad item in the cost opinion.

27. **Comment:** **Figure 7: The figure of the approximate containment wall location was very helpful in understanding the preferred alternative. Could the approximate locations of the well points also be included on this figure?**

Response: The figure has been revised to include approximate locations of the well points.

REFERENCES

PRC Environmental Management Inc. (PRC). 1992. Surface Confirmation Radiation Survey Draft Report. November 3.

PRC. 1994. Wetlands Delineation Report, Hunters Point Annex, San Francisco, California. January.

PRC. 1996. Removal Action Implementation Work Plan - Site IR-1/21: Industrial Landfill, Hunters Point Annex, San Francisco, California. May.

State of California State Water Resources Control Board (SWRCB). 1993. California Enclosed Bays and Estuaries Plan. Water Quality Control Plan for Enclosed Bays and Estuaries of California. 93-5WQ. April 11.

U.S. Environmental Protection Agency (EPA). 1993. Presumptive Remedy for CERCLA Municipal Landfill Sites. Office of Solid Waste and Emergency Response. EPA 546-F-93-035. September.